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OF
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THE

FARMERS AND FRUIT-GROWE

GUIDE.

THIRD EDITION.

ISSUED BY DIRECTION OF

THE HON. JOSEPH COOK, M.

Secretary for Mines and Agriculture.

COMPILED BY W. H. CLARKE,

EDITOR, "AGRICULTURAL GAZETTE."

SYDNEY: WILLIAM APPLEGATE GULLICK, GOVERNMENT PRINTER

1898.

[In Paper, 1s. In Cloth, 2s. 6d.]

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INTRODUCTION.

It has been recognised by the Department that the publication of a handbook on agriculture and kindred subjects would be a great help to those who, without previous experience, have settled on the land, and intend embarking in farming and fruit-growing. The preparation of the work has been undertaken at the direction of the Minister for Mines and Agriculture, with a view to assist those who enter upon this enterprise.

The matter has been gleaned for the most part from articles that have appeared in the *Agricultural Gazette*, and an effort has been made to confine the information to methods and crops that have stood the test of practical trial from season to season, not only by the Departmental staff of experimentalists, but by a large number of enthusiastic agriculturists throughout the Colony who have co-operated with the Department in determining the merits of the systems of culture advocated.

Care has been taken to secure accuracy of details so far as relates to the districts in which the trials have been made; but the fact must not be overlooked that, with the exception of the Plains, there are scarcely ten square miles of country in New South Wales precisely similar, and the novice must rely to some extent upon his judgment and observation in successfully carrying out the directions given.

The general principles of agricultural practice, however, vary little, and from the perusal of these pages it is hoped the beginner, as well as some of the more advanced settlers, will be able to get an idea of the lines on which the various branches of agriculture can be profitably pursued.

The Department of Agriculture has been established in the interests of the farming and fruit-growing community, and every one engaged in the cultivation of the soil is invited to consult the staff of experts with respect to any matters that affect crops, etc.

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The information contained in this work is of a general character, and the agriculturist must bear in mind that year by year, as competition becomes keener, the systems of culture and methods of disposing of crops are undergoing change. It is therefore necessary that the settler, if he desire to make the most of his land, should keep himself in touch with every advance made in practical agriculture. To enable him to readily do this the Department publishes each month the *Agricultural Gazette*, which contains the latest information procurable from reliable sources, and is supplied gratis to all *bona-fide* agriculturists throughout the Colony.

It is the desire of the Department to emphasise the advantages of mixed husbandry on small thoroughly-cultivated holdings. To this intensive system of agriculture, embracing rotation of crops and subsidiary aids, many countries that have attained agricultural prominence owe their success. In the comparatively few instances in which the practice has been adopted in this Colony satisfactory pecuniary results have followed, and it is generally found that where an orchard, live stock, dairy, poultry, bees, and other branches exist, not only are the profits greater, but the farmer is not so much exposed to the caprice of seasons, and the members of his household are provided with varied and interesting occupations.

Department of Agriculture,
Sydney, 14 *January*, 1897.

Since the above date many thousand copies of the *Guide* have passed into the hands of agriculturists throughout the Colonies and many parts of the world. On all sides the opinions of practical men and of the Press as to the completeness and utility of the work have been so unanimous that, in the preparation of the present edition, it has not been deemed necessary to do more than embody within chapters already defined the views of several Experts who have meanwhile joined the Department.

28 *September*, 1898.

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UNIV. OF CALIFORNIA

THE

FARMERS AND FRUIT-GROWERS' GUIDE.

How to acquire Crown Land.

[Published by Authority of the Department of Lands.]

There are several forms of lease and purchase by which this may be effected under the provisions of the Land Acts of the Colony, but the attention of persons of small capital desirous of securing a permanent home for themselves may be confined to the systems of conditional purchase, conditional lease (which is really interwoven with and dependent upon that of conditional purchase), homestead selection, and settlement lease.

It might perhaps here be explained that the Colony is divided into three divisions—the Eastern, Central, and Western; and these are again divided into one hundred and three land districts, with a Crown Land Agent resident in the principal town of each district. These land districts are grouped into thirteen Land Board districts, in the chief town of which the offices of the Chairman of the Local Land Board and the District Surveyor (who control and supervise land matters generally within the district) are situated.

Conditional Purchase.

This system, which is perhaps more commonly known as the free-selection system, dates from the year 1861, and, as the name implies, is a purchase in fee simple subject to the fulfilment of certain conditions.

These conditions are, in brief—residence for ten years, the fencing or other improvement of the land, and the payment of the purchase money by annual instalments, with interest at the rate of 4 per cent. per annum.

Certain lands are, of course, reserved or exempt, and cannot be purchased in this way, such as, for instance, land held under lease other than annual lease or occupation license; land in the Western Division of the Colony, except where such has been specially made available under the designation of special areas; land classified and set apart for homestead selection and settlement lease; land reserved from sale or otherwise specially exempted.

An intending selector must be of or over the age of 16 years, and his first step should be to inspect the maps kept for that purpose at the office of the Crown Lands Agent for the district in which he is desirous of settling, or at the District Survey Office, or otherwise apply by letter or in person to the Information Bureau of the Department of Lands in Sydney, from any of which sources he will readily learn what land is available for the purpose he has in view.

After having determined upon the land he wishes to select or purchase, and having ascertained that it is available for the purpose, it will be necessary for the selector, where the land has not been measured, to mark in a conspicuous manner and according to directions contained in the regulations to the Land Acts, one corner of the land; but should the land have been measured no such action is necessary.

The next step is to fill in the necessary particulars on the proper form of application, which may be obtained from any Crown Lands Agent, and to hand that application in person to the Land Agent on any Thursday between the hours of 10 a.m. and 4 p.m., together with a deposit of 2s. per acre, and a fee for the survey of the land according to the regular scale, which ranges from £4 for 40 acres, to £18 15s. for 2,560 acres.

The Local Land Board then, in due course, will hold an inquiry, and, if satisfied that the application has been made in good faith, and is otherwise unobjectionable, will (after survey of the land) approve of, or, to use the proper technical term, "confirm" the application. Within three months after confirmation, the selector must commence to reside, for although he may take possession of the land directly his application is lodged, he is not required by law to do so until confirmation has taken place. The term of ten years' residence is, however, computed, not from the date of confirmation, but from the date of application itself.

Three years from the date of application is allowed to elapse before another payment becomes due, and at the end of that time an instalment of 1s. per acre must be paid, and a similar amount at the end of each year thereafter until the debt is discharged. From each amount paid, with the exception of the deposit and the first instalment, interest at the rate of 4 per cent. on the balance due is deducted, and the remainder credited towards the purchase of the land. Three months' grace is allowed for the payment of each instalment, and in addition suspension of payment may be granted for one year in cases of temporary inability to pay; and where the instalment of 1s. per acre is found to press too heavily, the selector may, after he has reduced the debt sufficiently, obtain a reduction of the yearly instalment to 9d. or even 6d. per acre.

As regards the price to be paid for lands bought under this system, £1 per acre is the amount fixed, but land possessing any special advantages, and therefore of greater value, no matter in what division of the Colony it is situated, may be set apart under the designation of special areas, and the price in such cases ranges from 30s. per acre upwards. It should be noted that for land within these special areas, the deposit payable with the application is 10 per cent., and the yearly instalments 5 per cent., of the price of the land.

As regards the area which can be selected, the minimum is the same in both the Eastern and Central Divisions, viz., 40 acres; but the maximum is 640 acres in the former, and 2,560 acres in the latter. It does not follow, however, that the area first selected cannot be increased, for the law provides that a selector holding any area less than the maximum can make additional purchases of adjoining land, but not less than 40 acres at a time, until the maximum is reached, and without any further condition of residence so far as the *original* selector is concerned. Special areas are, however, an exception to the rule, as the maximum area is fixed by notification in the *Gazette*, and cannot exceed 320 acres in the Eastern Division and 640 acres in the Central Division.

Three years are allowed from the date of confirmation within which to fence the land; but the selector may dispense with fencing, provided he effects improvements of a substantial character to the extent of 6s. per acre within the time above mentioned, and brings their value up to 10s. per acre within the succeeding two years. In no case, however, need the expenditure exceed £384 within the first, or £640 within the first and second terms combined; so that the holder of a selection of 2,560 acres is practically placed on an equality with the man who has 1,280 acres as regards outlay upon improvements.

Sufficient has perhaps been said to give a fairly comprehensive outline of the conditions attached to this system of purchase, but it must be understood that there are several matters of minor importance which possibly would have no bearing on the generality of cases, and it is, therefore, hardly deemed advisable to introduce them here as this article is primarily intended for the guidance of those who have never previously held Crown lands, and also of those from other countries or the neighbouring Colonies who may be desirous of settling here. In this connection it may be mentioned that any person who is not a natural born or naturalised subject of Her Majesty must be a resident of the Colony for twelve months before he can apply for land under any of the forms mentioned, and then with his application he must make a declaration of his intention to become naturalised within five years. There is also another matter which may be of interest to an intending selector, and that is, that the land cannot be transferred during the first five years from the date of application. After the expiration of this period the Local Land Board will hold an inquiry as to whether he has so far fulfilled the conditions, and if satisfied a certificate to that effect will be issued, the possession of which will enable him to transfer his selection to another person, who would, however, be expected to complete any unfulfilled obligations. In the event of the death of the selector, the fulfilment of the condition of residence remains in abeyance pending the transfer of the selection.

Conditional Lease.

A conditional lease is associated with a conditional purchase. Only a person who is an applicant for or a holder of a conditional purchase is entitled to a conditional lease, and the land he wishes to secure must adjoin his conditional purchase. The maximum area that can be leased is limited to an area three times as great as that of the conditional purchase, but in no case must the area of the purchase and lease combined exceed 1,280 acres in the Eastern, or 2,560 acres in the Central Division. With his application, which must be made on the proper form, and lodged with the Land Agent, he is required to pay a deposit of 2d. per acre (which is taken as a provisional rental until such time as the Land Board may appraise the yearly value of the land), and also a survey fee, which is calculated at a lower rate than would be required for a conditional purchase. The lease has a term of twenty-eight years, and is subject to the same conditions of residence, fencing, or improvements as attach to a conditional purchase. The selector may, however, reside on either the purchase or the lease. The lessee has the right at any time to convert his lease either wholly or partly into a conditional purchase, but in any circumstances tenant right in improvements is secured to him when the lease expires.

Homestead Selection.

Another method by which land may be secured is that of homestead selection, and this system, like that of settlement lease, is of quite recent origin, having been introduced by the Land Act of 1895, and offers special facilities to *bona-fide* land seekers of limited means. The conditions attaching to a homestead selection are perpetual residence and perpetual rent, and a dwelling house to be erected within the first eighteen months after confirmation of the application, worth £20. There is no restriction as to the division of the Colony in which land may be set apart for homestead selection; but before land is so set apart it is ascertained to be suitable for the purpose, and is measured into blocks of sufficient area for the maintenance of a family, in no case exceeding 1,280 acres in extent. After a given date, which is notified in the *Government Gazette*, the land may be obtained by lodging an application on the proper form with the Crown Lands Agent, the earliest applicant on that day having the first right to the land, the only restriction as regards age being that the applicant must be of or over 16 years of age. With the application a deposit must be paid of one-half the first year's rental, and one-third of the survey fee, which is determined according to the recognised scale (this ranges from 15s. for 4 acres up to £11 1s. 3d. for 1,280 acres). The applicant is then entitled to take possession of the land, but is not compelled to do so until three months after the selection has been confirmed by the Land Board, when he must commence his residence. The rental is dependent upon the capital value of the land—being fixed at the rate of 1¼ per cent. on that value for the first five years and 2½ per cent. thereafter. This capital value is carefully determined beforehand, and advertised when the land is made available, so that an intending selector is made fully aware of his liabilities in this respect The first valuation holds good for fifteen years. Afterwards a reappraisement of the unimproved value takes place every ten years. After five years, if the Land Board issue a certificate that the conditions have so far been fulfilled, a deed of grant of the land is made out in favour of the selector, so that the title is a freehold one, subject to the payment of a perpetual rent and the performance of perpetual residence by the grantee, his heirs, and assigns. The condition of improvements is nominal, for all that the law requires is that the selector shall within the first eighteen months erect a dwelling-house of the value of £20. Should the land contain improvements when the selector applies for it, he is required to pay their value in four equal yearly instalments, with 4 per cent. interest added.

The condition of residence may appear stringent, but it is not inflexible, as for good and sufficient reasons, such as sickness, &c., exemption may be granted, but not for more than one year at a time, and there is also one special advantage conferred upon a homestead selector, which has so far not been extended to other purchasers from the Crown, and that is protection for his holding. By a simple process of registration at the office of the Crown Land Agent he is, if not in insolvent circumstances at the time, enabled to secure himself against the loss of his land through bankruptcy or other process of law.

Any person who is not a natural-born or naturalised subject of Her Majesty is debarred from selecting until he has resided in New South Wales for twelve months, and then when applying for land he must lodge a declaration of his intention to become a naturalised subject within five years.

Settlement Lease.

This system, like that of homestead selection, was introduced by the Land Act of 1895, and is a further attempt to place land within easy reach of the small capitalist, the main distinction between the areas set apart for settlement lease and those for homestead selection being that in the former case the land is chiefly suitable for grazing purposes, while in the latter it is anticipated that agriculture would provide a livelihood. Land is first classified and surveyed into farms, which may contain up to 10,240 acres. The capital value of the land is determined and a day fixed when applications will be received. Full particulars are published in the *Government Gazette* as to the character of the country, the capital value, the annual rental, and also as to any improvements that may be already in existence on the land. The rent, which remains unchanged throughout the whole term of the lease, is fixed at the rate of 1¼ per cent. on the capital value. The term of the lease is for twenty-eight years. Applications must be made on the proper form and lodged with the Crown Land Agent, together with a deposit of one half-year's rent and a survey fee, according to the proper scale. (This ranges from £34 7s. for 10,240 acres to £1 for 4 acres.) The application has then to be considered by the Local Land Board, and if found to be satisfactory, and in accordance with the law, it is confirmed, and a lease is then executed and placed in the Land Agent's hands for delivery to the lessee. The applicant may take possession of the farm immediately after lodging his application, but it is usual to allow three months to elapse after the date of confirmation before he is actually required to commence residence.

In addition to payment of the rent the conditions attached to the lease are: That the lessee shall pay the value of any improvements which may be on the land, either in one sum or in three equal yearly instalments, with interest at the rate of 4 per cent. per annum; that he shall reside on the farm and make it his *bona-fide* residence during the whole term; that he shall fence it within five years; that he shall not assign or sublet without the Minister's consent, and that he shall carry out any regulations made by the Minister with respect to keeping the farm clear of rabbits and other noxious animals, and also of scrub and noxious weeds. At the expiration of the lease tenant-right in the improvements is secured to the last holder of the lease, and during the last year the lessee may convert 1,280 acres into a homestead selection.

It may be mentioned that at the various Crown Land Agents' offices, or at the District Survey offices, or from the Information Bureau at the Lands Department, Sydney, full details of any land that is available for homestead selection or settlement lease can be obtained, and any other general information that an intending selector may require will be readily afforded.

Notes concerning some of the Features of the Land Board Districts of the Colony.

THESE notes are collated from returns sent in by inspectors of conditional purchases, foresters, and inspectors of stock, as well as from reports that have been prepared from time to time by officers who have inspected the various districts.

The officers have for many years in most cases resided in and travelled through the country reported upon, and may therefore be expected to have a good general idea of the subjects referred to. But readers will understand the variety of soil and climatic conditions in even a small district is considerable, and in the limited space available it is not possible to discuss, except in a general way, the features that may give an intending settler some idea of the class of agriculture for which the different portions of the Colony are adapted.

Data as to temperature and rainfall of each district are given in the chapter on Climate.

The figures with respect to clearing and fencing are approximate.

Armidale.

Armidale, Uralla, Walcha, Guyra, Bundarra, and Bendemeer.—The country is generally hilly, and though the soil is in some parts shallow, throughout the greater area all English fruits and farm crops grow to perfection. The district is naturally well watered, and, as a rule, for six months of the year there is plenty of pasturage for stock. Clearing ring-barked country costs from £2 10s. to £5 an acre ; green timber 30 per cent. to 40 per cent. more ; fencing from £28 to £35 a mile.

Glen Innes, Tenterfield, and Inverell.—Well adapted for mixed farming, including sheep rotation. Grapes, apples, cherries, plums, &c., wheat, oats, and potatoes are extensively cultivated, and do exceedingly well. Dairying is not carried on in a large way, although during the greater part of the year it could be inexpensively conducted. The district generally is very attractive and fertile.

Bourke.

The districts of Bourke, Brewarrina, Cobar, and Wilcannia are chiefly adapted for sheep ; cultivation can only be carried out with any real success by means of irrigation. The soil in many parts is, however, eminently adapted for the production of a large variety of crops and fruit. The Department has established at several of the artesian bores throughout these districts small experimental farms, around which land can be leased. There is good local demand for fodder, fruit, and farm produce of all kinds.

Cooma.

Monaro.—Basaltic plains, slate and limestone plains; open gum-forest country of granitic formation; light-cropping soil. Apples, plums, gooseberries and blackberries grow well. The rainfall in most parts of the district is not sufficient generally for agricultural purposes, though oats, hay, and potatoes are found to do well, and in some seasons wheat yields very well. There is some scope for dairying. Clearing costs £1 to £2 an acre; fencing, £17 10s. to £20 for stud fence, and £30 to £35 a mile for wire.

Cooma.—Farming has not been carried on to any extent in this district. The climate is uncertain, and the country generally stony and broken. Frosts begin in April and extend to November, and sometimes even later. Grazing is the principal industry. In sheltered parts English fruits, cereals, and roots do well. The district is well watered by rivers, springs, and creeks. Clearing, £1 to £2 per acre; fencing costs £27 to £35 a mile.

Braidwood and Queanbeyan.—Generally mountainous, with small rich plains and fertile, undulating, open forests. Nearly all English fruits do well. Cereals and roots grow to perfection.

District fairly well watered. There is considerable scope for dairying. Artificial grasses would succeed admirably.

Bega, Eden, and Moruya.—Good dairying country. The soil of the river flats is black alluvial of great fertility.

Milton.—Chiefly trap hills and valleys. Very productive. Especially adapted for dairying. Very little land available.

Dubbo.

Coonamble.—Mostly open plain country, with belts of timber and considerable areas of scrub. In the open country the soil is chiefly rich black loam, which bakes hard in dry weather. In the timbered portions the soil is reddish in colour and more friable. Very little cultivation has been attempted in this district. Irrigation would be necessary, but the want of sufficient permanent water renders this impracticable.

Dubbo.—Hilly in parts and running out into plain country. Soil, principally reddish clay loam. Wheat, oats, maize, potatoes, pumpkins, melons, and all sorts of vegetables do well; citrus fruits, apples, peaches, and nearly all kinds of stone fruits, as well as grapes, thrive. The district is well adapted for fruit-drying. The black soil along the river flats produces lucerne to perfection. Bees do well. Seasons unreliable. Tanks and dams are necessary. Excavating about 1s. a cubic yard. Fencing costs about £28 to £30 a mile (six-wire). Clearing—Grubbing, 1 ft. 6 in. deep, 10s. to 20s. an acre. Timber that has been ring-barked three or four years can be cleared for much less—in some cases a few shillings.

Forbes.

Condobolin.—This district is chiefly pastoral.

Forbes.—Well adapted for wheat, oats, barley, rye, maize, sorghum, lucerne, and root crops. Dairying can be profitably carried on, and the district is eminently adapted for all kinds of fruit. There is also scope for bee-farming. Tanks are necessary for conserving water, and are usually excavated at about 8d. a cubic yard. A good supply of water can be obtained by sinking 40 to 60 feet in most of the country contiguous to the Lachlan. Clearing costs £2 10s. to £3; fencing, about £30 a mile.

Grenfell, Barmedman, and South Condobolin.—These districts comprise all classes of land, but the general character of the country is undulating and level, bearing ironbark, box, varieties of gum, and pine. Wheat is largely grown, and the district is suited for many other crops and fruit-growing. Water conservation is necessary; tanks and dams can be made at the cost of about 9d. per cubic yard. Clearing—Grubbing timber, about £1; scrubbing, about 5s. an acre. Fencing—Ordinary wire, £30 to £32 per mile; rabbit-proof (Schedule 6) fencing, £55 to £60 per mile.

Grafton.

Port Macquarie.—This district can be recommended to the beginner with small capital. The soil is rich, and many branches of agriculture can be successfully carried on. The high lands are grassed with good natural fodder, while the low lands are clothed with what is locally known as Swamp, seven oats, or buffalo grass, and for autumn or winter feed it is unequalled for dairying or fattening purposes. Tanks or dams are rarely needed, as the country is well watered, and droughts of long duration are unknown. The chief drawback is the periodical flooding of the Macleay. Maize thrives wonderfully, and citrus fruits do very well. Dairying, pig and poultry farming, are industries for which the district is eminently adapted.

The North Coast District.

The climate of the north-eastern portion of New South Wales is marked by great and sudden variations of temperature. Although in summer the heat is at times very great during the daytime, especially on the banks of the rivers, a considerable fall in the temperature takes place, and in most parts cool nights are enjoyed, and vegetation which has suffered from the heat of the day becomes refreshed.

Hot winds are of comparatively rare occurrence, and in all respects the climate is far more tolerable than is supposed by most residents of the southern districts. On the high lands towards the coast the climate is more equable, not reaching the extremes of heat and cold recorded on lower levels near the rivers.

During the last two years the highest shade temperature registered at the Experiment Farm, which is situated on the Lismore–Ballina road at an elevation of about 500 feet, was 104 degrees Fahr., the lowest being 35 degrees Fahr.

For some years the frost has been unusually severe in its effects on low lands, in some places destroying fairly well-grown indigenous trees. This will probably tend to show the limits within which the cultivation of certain crops should be confined, in order that farmers may reckon with some degree of certainty on saving the crops they have planted.

The losses through "frosted" cane have been unusually heavy; but so far as we can learn no attempt has been made to minimise the loss by adopting the practice of "windrowing" or stacking the cane, as carried out in the United States. As it is impossible for the mills to treat all the cane that becomes "frosted" within the time necessary to save it under ordinary conditions, it is possible that the adoption of the system of "windrowing," which has given satisfactory results in America, may greatly reduce the loss and make the sugar industry more hopeful from a climatic point of view.

The selection of vigorous plants of strong varieties, with more thorough tillage, should also render the probabilities of its still proving a paying crop much greater than it has been under the system of planting and cultivation far too generally observed.

The unequal distribution of the rainfall is also a source of difficulty to agriculturists, as usually two-thirds of the annual rainfall are recorded in the first quarter, the rain during the latter part of the year often proving insufficient for the success of many crops, especially in the red volcanic soil which comprises a large proportion of the Richmond River district.

The alluvial flats of the Clarence, Richmond, and Tweed Rivers, which are probably unsurpassed in fertility by any portion of the colony, do not, however, suffer to the same extent under a light rainfall, as they possess far more retentive soils.

The dairying industry being one which is rapidly becoming of great importance in these districts, much attention has been given to the testing of grasses and fodder plants for the purpose of ascertaining the most profitable varieties for culture. A full report of these trials will be found in the *Agricultural Gazette* for August, 1896. Owing to the prevalence of dry weather and cold winds in winter the pastures suffer to a great extent, and the subject of providing for that season by growing suitable fodder is a most important one, the urgency of which is recognised by a small minority only of those engaged in dairying, most of them being averse to the labour required in "hand-feeding."

During the summer heavy crops of fodder can be raised at comparatively small cost, and as at that time the pastures are at their best, provision for winter might be made with considerable profit to those engaged in dairy farming, who would preserve the surplus fodder by means of ensilage for use in the time of scarcity.

Full instructions for the preparation of silage are given at page 101.

Excellent crops of barley, vetches, oats, &c., may be raised for cutting in the winter, and for the early part of the season late sown Planters' Friend will be available.

The suitability of the higher lands of the Richmond River district for the successful culture of citrus fruits is amply demonstrated by the fine specimens of trees of that tribe which are to be met with in many parts, thriving in spite of neglect and bad treatment.

The volcanic soil is so well drained naturally that in well chosen situations no ill results follow the excessive rains of our periodical wet seasons, as would be the case in soils more retentive of moisture.

The subject of the culture of citrus fruits is exhaustively dealt with by Messrs. Benson and Allen, page 272.

The cold has proved too severe for many of the tropical fruits which have been tried, while others, such as the banana, pineapple, guava, papaw, mango, and granadilla, may be successfully grown, especially on the eastern slopes lying towards the coast.

Other crops, such as cane, fibres, coffee, oil plants, and miscellaneous products, which have succeeded or appear to be in a fair way to succeed, are dealt with in detail, and the methods found most successful in their culture, described.

Goulburn.

Goulburn, Crookwell, Gunning, Collector, Marulan.—This district is better adapted for fruit-growing than general agriculture, on account of hilly and stony nature of land, except in patches. The soil is good. Clearing is done by grubbing and burning, and at times with forest devil, at from £3 10s. to £4 10s. per acre. January to March best time to ringbark. The timbers used for fencing are water gum, peppermint, stringybark, and mountain ash, and are available in limited quantity. Fences as a rule are posts and wire, costing from £25 to £32 a mile; but as marsupials are numerous, cultivated areas require netting. Apples, pears, plums, apricots, cherries, gooseberries, quinces, mulberries, and raspberries thrive; walnuts do fairly well; peaches are liable to blight; the codling moth is troublesome; wheat, oats, rye, barley, potatoes, turnips, pumpkins do well; sorghum and maize best crops for ensilage. The district is generally well watered. Plough and small scoop are generally used for dam-making. The natural pasture is good, and is much improved by admixture of rye, white clover, cocksfoot, and other artificial grasses.

Boorowa.—This country is well adapted for general agriculture, and there is scope for dairying and fruit-growing.

Harden, Murrumburrah.—Good cereal country.

Picton and Berrima.—This district is to a great extent adapted for dairying. Wheat and oats for hay, Planter's Friend and broad-cast maize for ensilage, are among the principal crops. English fruits thrive at Berrima. The water supply is good. Clearing costs £3 to £5 per acre; fencing, £25 to £30 a mile.

Yass.—Cultivation has not received general attention in this district. It is, as a rule, fairly well watered, and only small dams are required.

Young.—Ridgy and undulating country of granite formation, timbered with white and yellow box, pine, and some stringy-bark. Especially adapted for wheat, oats, barley, sorghums, and millet. Cherries and plums grow to perfection; grapes and apples do well. Tank or dam making necessary, costing on an average about 8d. to 1s. a cubic yard. Clearing, about £1 to £3 per acre; fencing (six-wire), about £30 a mile.

Hay.

Hay, Hay North, Hillston, and Hillston North.—The north-east or Hillston portion is principally undulating country, the greater part of which is covered with pine, belar, and mallee scrub, interspered with open country and small plains. In the eastern portion there are strong basalt mountains, covered with carraway scrub. The balance of the country in the district is principally open salt and cotton-bush plains, with box and gum on river frontages, and in scattered clumps. The open country is best adapted for grazing. The scrub country, when cleared, at a cost of from £1 to £2 per acre, produces good wheat, and there are considerable areas of loamy soil on which lucerne could be successfully grown. All kinds of fruit do well, and the district is "early." Ordinary six-wire fencing costs £27 10s. to £35 a mile, rabbit-proof netting £20 to £30 per mile more. Tank-making costs about 8d. per cubic yard.

Deniliquin.—Chiefly pastoral country, but there are considerable areas suitable for agricultural purposes. The flooded portion is not well adapted for farming, but in the red loamy districts cereals do well, while vines and fruit of all kinds thrive to perfection on the sand-hills. Fencing costs about £30 a mile. Clearing costs from £1 to £3 per acre. Tank-making varies from about 4d. per cubic yard.

Balranald.—Farming in this district is precarious, the rainfall being insufficient, and the soil generally poor.

Ivanhoe.—This district is used for wool-growing, as there is not enough water for dairying or fruit-growing.

Moama.—The country is generally level, intersected by belts of timber, and occasionally loamy sand hills clothed with pine. On the river frontages the timber is red gum. Clearing the pine costs very little; the red gum runs into £3 to £5 an acre. Ordinary wire fence £30 a mile. It is generally considered that the rainfall is too uncertain for successful dairying, but by means of irrigation a great variety of crops and fruit could be produced.

Maitland.

Singleton.—A large proportion of this district is especially adapted for vineyards; but lucerne, maize, barley, and vegetables are most successfully grown on the dark heavy rich alluvial loams, and summer and citrus fruits, wheat, potatoes, and root crops do well in the lighter upland loams. The method of conserving water is generally by means of a tank, with the earth excavated thrown up to form a dam. Clearing costs £1 to £4 an acre. Fencing varies from £30 a mile.

Merriwa.—The chief crops are maize and wheat. The district is well watered, and is well adapted for farming. Lucerne succeeds well on the flats, and, by means of irrigation from the good water supply available, most crops could be grown.

Gosford and Brisbane Water.—This district is rough and broken in places, and comprises land of all descriptions from poor to good. Its chief advantage is handiness to the metropolis. Maize and general farm crops do well, and apples, peaches, nectarines, quinces, loquats, some varieties of plums, and citrus fruits thrive. Clearing is costly, ranging from £10 to £20 per acre. The usual fence is split posts and two-rail with wire netting, costing about 4s. a rod.

Paterson and Muswellbrook.—A considerable portion of these districts is well adapted for farming, dairying, vine and fruit growing. Clearing runs from about £1 to £4 an acre, while the average cost of top-rail wire fence with netting or palings is from £40 to £48 a mile.

Cassilis is essentially grazing country.

Taree, Stroud, and Dungog.—There is not much of the area embraced by these districts suitable for general agriculture. Maize is extensively grown on the river flats, and does very well. Many other crops, such as lucerne, potatoes, and sorghum, do well in places, and nearly all kinds of fruit will grow. Clearing costs from £1 to £4 an acre, and a two-rail fence costs, as a rule, about £32 a mile.

Metropolitan.

Campbelltown, Wollongong, Kiama, Nowra, Milton, and Gerringong.—These districts are admirably adapted for dairying, and the greater part is also suited to general agriculture. Grubbing by hand, at a cost of from £5 to £9 per acre, is the principal mode of clearing. Fencing costs about 14s. a chain in districts when it is necessary to make enclosures vermin-proof.

Windsor.—On the banks of the Nepean, Hawkesbury, and Colo Rivers corn is the principal crop. Pumpkins, melons, turnips are also largely grown. During this season large areas of potatoes and onions have been planted, and give promise of a good yield. Lucerne and oats are grown to a considerable extent, and flourish. In early years wheat was largely grown, but now rust makes its appearance, and the crop is not persevered with. Citrus fruits are produced to perfection, especially in the Emu Plains and

Kurrajong parts of the district. Stone fruits of every kind, except the cherry, thrive, and numbers of new orchards are being laid out. There are several vineyards in the district, where wine is extensively made. Strawberries do well, and high prices are obtained for early crops, which are grown in sandy soil at the head of the Nepean River, and in many other portions of the district.

Moree.

Moree, Warialda, and Bingara.—Partly mountainous, with rich chocolate loam and sandy soil, and partly black soil plains; but owing to the mechanical difficulty of working this black soil, agriculture can scarcely be carried on at a profit. Around Warialda there is a considerable area well adapted for wheat, oats, maize, lucerne, and fruit. Timber—ironbark, pine, box, belar, and brigalow. Clearing costs from 15s. to £3 per acre, according to nature of timber. Fencing from £25 per mile to £35. Tanks of considerable size indispensable.

Walgett.—The soil is well adapted for fruit and farm crops, but water supply precarious.

Orange.

Bathurst.—The soil around Bathurst (disintegrated granite and Silurian rocks) appears to be shallow in many places, but the alluvial flats on the banks of the Macquarie River and its tributaries are deep and extremely fertile, and here could be raised with a little care enormous crops of various kinds. Lucerne and tobacco are grown on these flats, and thrive well. The principal crops grown are wheat for grain and oats for hay.

Carcoar.—There is not much land available that is suitable for general farming purposes, but what there is will produce wheat, potatoes, oats, lucerne, and, under good cultivation, turnips. Fruit does well. The natural supply of water is good. Clearing and fencing, *see* Orange.

Cowra.—Generally suitable for agriculture. Red soil of basaltic formation. Natural water supply poor. Well adapted for fruit-growing. Clearing and fencing, *see* Orange.

Lithgow.—There is only a small proportion of this district fit for agriculture. Cereals and fruits adapted to a cool climate do well in places. Stringybark, box, and gum, with a little ironbark, are the principal timbers. Clearing costs from £2 to £8 per acre. Fencing—log, £16 to £40; wire netting, £40 per mile.

Molong.—Red soil, white box forest country, well adapted for farming and, in parts, fruit-growing. The natural water supply is fair. Dairying could be carried on, but much would depend upon the seasons. Lucerne will do well. Clearing and fencing, *see* Orange.

Mudgee.—Parts of this district are fairly adapted for agriculture, but the country is very hilly. Grapes and English fruits do well, and on the flat country there is considerable scope for dairying.

Orange.—There is not much land available in this district for agriculture. What there is produces excellent crops of cereals, pumpkins, and roots. English fruits thrive to perfection. The fattening of crossbred sheep is an industry for which this district affords considerable scope. Clearing varies in cost from £1 to £3 an acre, while fencing in the level country (six or seven wire; eight wires would be required for crossbreds) runs from £26 to £30 per mile. In the rough and thickly-timbered country a good stud or drop fence, lasting about six years, can be erected at a cost of £16 to £20 a mile.

Wellington.—The river or creek flats well adapted for general farming and dairying; the gently undulating country suitable for wheat growing, orchards (all classes English fruit), and vineyards; the balance of the country best fitted for grazing. Clearing and fencing costs about the same as the rates quoted for Orange.

Tamworth.

Coonabarabran.—The district is well-adapted for general farming and fruit-growing. All areas available for farming require clearing, which can be done from £1 to £4 per acre, according to density of timber, and whether ringbarked or green. Marsupial-proof fences are necessary for cultivated areas. Tanks of about 2,000 yards capacity are found to answer best. Dams do not last long. Wheat, maize, and lucerne do very well. The native grasses are mostly "reedy," and require to be eaten down by large stock, when a fairly soft grass springs up, especially in ringbarked country.

Murrurundi.—Wheat, oats, barley, maize, lucerne, rape, and most fodder crops do well. Fruit in parts does splendidly. The district is permanently watered by creeks. Clearing and fencing—see Tamworth.

Narrabri, Gunnedah, and Coonabarabran.—Chiefly plain country; open box and pine forest. The climate is fairly reliable; the soil, with the exception of a considerable area between Narrabri and Coonabarabran, including Baradine, and skirting Pilliga and Wee Waa, is excellent. Water is obtainable in many parts by sinking. Land intended for cultivation is usually ringbarked—the best time to do this is after heavy rains—and left three or four years, when the trees are burnt off, or the green timber may be hauled down (p. 133). Marsupial-proof fences for cultivated areas are necessary. Grapes, figs, quinces, and citrus fruits thrive. Other fruits have not received much attention. Nearly all ordinary farm crops—especially wheat, maize, and vegetables—do well. For dairying, irrigation on a small scale might be advisable, in order to make sure of regular supplies of green fodder.

Tamworth.—The river Peel flows through this district. The alluvial flats along its banks are extremely fertile, and large crops of various kinds are produced on those portions under cultivation. Above these flats are the uplands, gently undulating away for miles to the south, south-west, and west, and hardly any of this country is under cultivation, although it is capable of producing excellent crops of cereals, vegetables, or fruits. On the alluvial flats, the farmers cultivating very small areas make good incomes. On these flats are located many small farmers, chiefly Chinese, who, in dry seasons, irrigate their land from wells in a very primitive manner, and produce good crops of cereals, vegetables, tobacco, and lucerne, much of which is sold green, for use in the town. Excellent lucerne seed is produced here also. The chief crop grown in this district is wheat, and the yield of this, under favourable circumstances, is very great, as much as sixty bushels to the acre having been obtained. Maize and potatoes yield excellent crops under irrigation, and as there seems to be a good supply of underground water, irrigation could be carried out to a certain extent inexpensively by the aid of windmills. Hungarian millet and sorghum yield immense crops in the dry seasons when irrigated; at the same time, that not irrigated will barely grow. Fruit of great variety and in great quantity could be produced here; peaches, nectarines, plums, grapes, olives, figs, lemons, &c., thriving well. In the colder parts of the district (near Nundle), raspberries, gooseberries, strawberries, and all kinds of English fruit grow and bear in great perfection. Within a short distance of Tamworth are immense quantities of mountain limestone, which will be of considerable value for agricultural and other purposes. The quality of the lime made from this limestone is excellent. The timber consists of box, ironbark, stringybark, redgum, and pine. Clearing costs from £1 to £4 per acre; fencing, about £30 a mile.

Wagga Wagga.

Albury.—Cereals of all kinds. lucerne, tobacco, grapes for wine-making, and all kinds of fruit do well. There is considerable scope on the river flats for dairying. The cost of conserving water is nominal; natural supply ample.

Cootamundra.—A considerable portion of the district suitable for small farms, fruit and vine growing, bee-farming, poultry-raising (especially turkeys). Water supply precarious—tanks and dams necessary. Excavation costs about 6d. a cubic yard; clearing scrub, 1s. 6d. to 2s. 6d.; green timber about £1, and dead trees about 10s. an acre. Fencing (6-wire), about £30 a mile; drop fence, where timber is procurable, £20.

Corowa.—Cereals (with the exception of maize), fruit of all kinds, and grapes particularly, do remarkably well. Lucerne is found to succeed, and large areas are now under that crop for pasture. It is necessary to conserve water. Tanks of not less than 2,000 yards are recommended. Cost of excavation averages about 9d. a cubic yard. Most of the timber has been ringbarked, and clearing is, therefore, not a heavy item. Fencing costs about £30 a mile.

Gundagai.—A considerable portion of this district is well adapted for the purposes of the small farmer. Fruit does splendidly. There is scope for dairying, bee-keeping, and poultry-raising (especially turkeys). Water supply very good; clearing costs from £1 to £2 an acre, but price varies considerably; fencing (6-wire), about £30 a mile. Where suitable timber is available a substantial drop fence can be erected for about £20.

Jerilderie.—This is essentially a grazing and wheat-producing district, but is well adapted for general farming and the production of fruit. Water conservation, by means of tanks, is a necessity, and excavation costs from 4½d. to 6d. a cubic yard; fencing costs about £30 a mile, but clearing is not a big item.

Narrandera.—This district is well adapted for the production of a great variety of farm crops and fruit. Nearly two-thirds of the area comprise red loamy soil, deep and very easy to work; a portion sandy ridges, also fit for cultivation; the balance, stiff clay suitable for grazing, but unfit for the plough. The river flats are rich, but cannot be cultivated on account of uncertainty of floods. At present wheat is the principal crop, but wherever fruit and miscellaneous crops have been tried they have succeeded admirably. It is necessary to conserve water in tanks. Excavation costs from 7d. to 10d. per cubic yard. Clearing is merely nominal—the pine forest costing about £1 or a little more per acre. There is, however, considerable demand at the local timber mills for pine, and all fair sized trees can be disposed of at profitable rates. Wire fencing costs about £30 to £36 per mile.

Tumut.—This is a wonderfully fertile district, having about 23,000 acres of alluvial land and about 170,000 acres of rich forest land. The chief crops grown are maize, wheat, hay, and tobacco. Compared with other maize-growing districts of Australia and America the yield in this district is extremely high, and tobacco will give from 10 to 20 cwt. per acre. 18 tons of potatoes have been taken from one acre on the alluvial flats. Lucerne also does well. Pears, apples, plums, apricots, peaches, nectarines, cherries, walnuts, almonds, grapes, raspberries, strawberries, blackberries, gooseberries, and figs produce enormous crops of fruit of excellent quality. Barley, rye, &c., grow splendidly.

Urana.—This district is chiefly devoted to sheep. Cereals and many kinds of fruit do well. Tanks and dams which are indispensable are excavated at about 7d. a yard. Clearing is not a big item.

Wagga Wagga.—The capabilities of this district can best be ascertained by perusal of the list of crops produced at the Department Experiment Farm. There are approximately over 2,000,000 acres of land in the district similar, and, in some cases, superior to that of the Farm. Clearing is done for about £2 10s. an acre, and fencing costs from £30 to £36 a mile—in some parts a little more. Water has to be conserved in tanks, and excavation costs 9d. to 1s. a yard.

Climate.

By H. C. RUSSELL, B.A., C.M.G., F.R.S.,
Government Astronomer.

Rain and Temperature Maps, New South Wales.

The four following maps of New South Wales have been prepared with the object of placing before farmers and others the most important particulars of the climate.

The first of these maps gives for each square degree in the Colony the average annual rainfall, and this mean has in all cases been derived from a number of stations with observations extending over a series of years. Accidental variations, due to violent local rainstorms, are in this way prevented from distorting the average. It is of course well known that in droughty years rains are very local; they come on, in most cases, with severe thunderstorms, covering small areas, and at times a distance of 10 miles may suffice to separate two rainfalls, one of which is eight or ten times the amount of the other. On the other hand, good seasons are marked by rainfall evenly distributed over large areas.

In preparing this map, each square degree was treated as if wholly separated from others, and when the average rainfall had been computed from the available observations made in it, the average was written down, and the next degree taken and treated in the same way.

When the map was finished one very remarkable fact became evident, which is, that following each degree of latitude, and beginning in the extreme west, the rainfall steadily increases; while, if the degrees of longitude are followed down, there is very little variation until we approach the River Murray, where it begins to increase, as if the oceans to the south and east each had the effect of increasing the rainfall; and such is in all probability the fact.

Annual average Rainfall.

The question—What is the best form of presenting to the busy man the facts which result from rainfall observations?—has been answered in various ways; and rain-maps, made with the object of presenting to the eye in a shape easily received the results of volumes of figures, may be divided into three kinds. First, those in which varying shades or intensities of colour convey to the mind's eye the amount of the rainfall in different parts of a country, or it may be of the whole world. For example, we have the rain-maps published by the Meteorological Department of India, in which nine shades of the same colour (blue) are used to indicate districts in which different quantities of rain fall, the amount varying from 0 to 100 inches. The same method, with variations, has been adopted in America, Canada, Victoria, South Australia, France, Germany, and other countries, and the

same method was used by Professor Elias Loomis in picturing on a map of the world the amount of rainfall in every place where it is known.

This method is undoubtedly valuable to the student who is looking at the question of general distribution of rain over large areas, but it does not give the practical and easily-read details wanted by the agriculturist and others. The jump from one shade to another is sometimes as much as 10 inches, and it must be admitted that this method of picturing the rainfall fails to give that fullness of information which other methods afford, and in that which follows the average annual rainfall for each square degree is given.

Second, we have the diagram form of rain-map. One of the earliest of these was our spot-map, as it is familiarly called, in which a round spot indicates the locality of each observer and the quantity of rain recorded. In Java spots are used, but all are the same size; and the quantity of rain is shown by the number of rings in a spot, not by the diameter of the spot, and it does not convey to the eye the relative quantity of rain so well as that in which the size of the spots is in proportion to the amount of rain.

In 1880 Mr. G. J. Symons, the well-known author of "British Rainfall," adopted a diagram form in which a simple spot indicates an average quantity of rain. The signs + and — show excess or defect of rainfall from 10 to 25 per cent., either sign enclosed by a ring, quantities over 25 per cent. The same author, in 1884, made a diagram in which the length of a vertical line shows the quantity of rain in each month, and twelve such lines placed side by side show the rainfall for the year for each district in which they are placed. The Meteorological Office of the United States draws on some rain-maps lines of equal rainfall in addition to the shading, which define more clearly the limit over which the same quantity has fallen.

Third, those in which the quantity of rain is shown by actual figures, located so that they indicate the rainfall for the district in which they are placed. One of the first of these, if not the first, forms part of the report on the meteorology of the Bombay Presidency for 1878, and shows the rainfall there for 1874 and previous years. In this the country is divided by red lines into small areas, in which each individual record is given in black ink, and the mean of all is given in red ink; but the effect is not pleasing, and the information not rapidly assimilated.

In New South Wales we first used large figures, locally placed, to indicate the mean rainfall over this Colony in 1883. The figures were large enough to be read at a distance of 6 or 8 feet, the object being to make it possible to see the quantities easily; and they are so conspicuous that they remain as a mental picture not easily forgotten. At that time observers were not so numerous as they are to-day, and for considerable areas there were no observers. The number has gradually increased, and is now more than 1,500. In the new edition of the 1892 map which follows, we have been able to get several stations in each square degree of the Colony. The mean of the records in each square degree has been taken as the average rainfall for that area, and this quantity is shown to the nearest quarter of an inch in large figures on the degree, while other smaller figures show the number of years over which the observations have extended, and the number of stations used to find the mean.

This rain map gives most complete information about the average rainfall of the country, and at the same time it shows in a conspicuous manner lines of equal rainfall, and makes prominent areas of heavier rainfall; and it gives at the same time what the shaded map cannot give, viz., the actual variations in the rainfall in each of the square degrees of these areas of heavier rain. It was specially prepared to meet the wants of the pastoralist and agriculturist.

It will be noted that the amount of rain increases with remarkable regularity in each latitude from west to east, save here and there a slight irregularity due to differences of elevation, and in one or two instances to the records not having extended over a sufficient number of years to eliminate the effect of dry periods. There are, however, one or two places where the variation from this regularity cannot be explained in this way, notably the head of the Hunter River valley, where proximity to the sea and the mountainous character of the country would lead us to expect a greater rainfall than that shown. There are ten stations there, and records extend over twenty-three years; so that there must be some local condition affecting the rainfall.

It will be observed that the lowest average annual rainfall in the whole Colony is found in the extreme west, and is 9½ inches. Along the valley of the Darling it is from 10 to 18 inches, and along the valley of the Murray it is from 12 to 26 inches, while our heaviest average rainfall (73¾ inches), is found on the Tweed River, which runs at the foot of a range of mountains, some of which rise to a height of 5,000 feet, and cause this heavy rainfall by intercepting the east and south-easterly winds.

This average rainfall map includes all the rainfall records up to the end of 1895.

Average Rainfall in each Month.

At first sight this map looks like a confused mass of figures, but that impression disappears as soon as the method of arranging the figures is understood. In the first place, each square degree in the Colony is treated as quite independent of all the others, and the average rainfall in that degree for each month of the year was calculated from the rainfall records in it. The quantities of rain in each month are then expressed in the usual way in inches and hundredths of an inch, and the months of the year are arranged in four rows, each row covering a quarter of the year—thus the first row in each degree reads January, February, March; the second, April, May, June; the third, July, August, September; the fourth, October, November, December.

Now, let us assume we want to know what rain to expect in each month in some particular place—say Bourke. We refer to the map and find it is situated in a degree in which the average rainfall for January is 2·63 in.; for February, 2·00 in.; for March, 2·06 in.; for April, 1·37 in.; for May, 1·56 in.; for June, 1·35 in.; for July, 1·23 in.; for August, 0·97 in.; for September, 1·16 in.; for October, 1·22 in.; for November, 1·21 in.; for December, 1·57 in. January is thus seen to be the wettest month with 2·63 in., and August the driest with 0·97 in.

One reference to the map shows that this mechanical arrangement of the figures gives the desired information in much less space, and is much easier to read than in any ordinary tabular form. Let us, for the sake of comparison, take another degree—that in which Lismore is situated—and the corresponding monthly rainfalls stand out in remarkable contrast with those for Bourke. In January, they have 8·50 in.; February, 8·64 in.; March, 12·74 in.; April, 7·82 in.; May, 6·73 in.; June, 4·17 in.; July, 4·58 in.; August, 4·32 in.; September, 3·83 in.; October, 3·75 in.; November, 3·88 in.; December, 4·96 in.; while here, the wettest month, March, has 12·74 in.; and the driest, October, 3·75 in.

In the northern districts west of Bourke, January is the wettest month of the year, and the half year, January to June, has much more rain than

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the second half. Eastward of Bourke, February begins to claim with January the highest rainfall, and the proportion of rainfall for the second half of the year is much better; and from Walgett eastward, February is generally the wettest month until we reach the highest lands, where the rainfall is very much greater than it is at Bourke, and then January again takes the lead for quantity of rain.

On the northern coast, March is the wettest month, with January, February, and April, in many places nearly equal; and although there is more frequent rain on the coast in the latter half of the year, the first half still maintains its superiority as to quantity. In the extreme west of the central districts, about Broken Hill, Wilcannia, and Menindie, May is the wettest month, and the rainfall in the second half of the year is better than the first in some cases. Eastward from this area for 200 miles, the wettest month oscillates between January and February, and in these districts there is a noteworthy increase in the quantity of rain generally, and in the first half of the year particularly, and also in what may be called the wheat-growing months, October and November; thence further east to the high lands the rainfall of the second half of the year gradually becomes greater than that of the first half, and in cases includes the wettest month, the fall during October, November, and December being favourable to wheat-growing. Still in the central districts, but on the coast, February, March, and May, by turns, represent the wettest month, and the latter half of the year has an abundant rainfall.

In the southern districts west of Balranald, May, or October is the wettest month, and the latter half of the year has a good rainfall. In Riverina, between Balranald and Urana, May is in all places the wettest month, while the rain of the latter half of the year is about equal to, and in some cases better than, during the first half. From Urana eastward to the mountains the wettest month on the Lachlan is January. In the district indicated by Temora, Wagga Wagga, Albury, and Urana, the wettest month is in some places October, and the rainfall in the latter half of the year is equal to, or in some places greater than, that of the first half of the year. On the high lands, here, as in the north, January is the wettest month, and January, February, March, October, November, and December have much more rain than the other six months.

It is needless to go into greater detail; the information is designed to be read in detail on the map, where locality as well as quantity of rainfall are given in the most convenient form for reference, and the suitability of the rainfall for wheat-growing and other purposes can be seen at a glance.

Places where wheat cannot, and others where it can, be grown, because the rain is abundant in the spring and early summer.

For instance, it would be folly to try and grow wheat in the extreme north-western districts, not only because the rainfall is much below the quantity (20 inches per annum)* which is required for that purpose, but also because of the fact that the bulk of the rainfall is in the first half of the year. These relations gradually improve in every direction, east, south-east, and south, as we leave the north-west, and reach their most favourable relations in eastern Riverina, where the rainfall is specially favourable for wheat-growing.

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* For the 20-inch limit see average "Annual Rainfall Map."

Temperature.

Temperature is one of the most important factors of climate in relation to vegetation, and two maps have been prepared with the object of making the temperature conditions of each part of the Colony easily accessible. For this purpose the Colony is divided into square degrees, and the figures necessary to give the desired information are placed in each square.

The Map showing Seasonable Temperatures.

In this map there is given in the corners of each square degree the shade temperatures of Spring, Summer, Autumn, and Winter; Spring in the upper left, and Summer in the right-hand corner. In the centre the average annual shade temperature; also the highest shade temperature ever recorded, and the lowest. That is the extremes of temperature to which plants may be for a short time subjected.

The extreme range of temperature in the hottest part of the western districts, in the course of years, is invariably less than 100°. The highest shade temperature in the Colony during the 20 years over which records for the Western Districts extend is 127·0°, at Bourke, and the lowest shade temperature ever recorded there is 28·0°. The extreme range, therefore, at Bourke is 99·0°. The nearest approach to the temperature and range at Bourke which is to be found in the Northern Districts is a max. of 119·9°, on the Barwon River, near Collarendabri, with an extreme low temperature of 21·1°, and range 98·8°. In the south-western parts of the Colony the records of very high temperature cover a wider area than they do in the northern. Thus, at Deniliquin, we find an extreme temperature of 122·0°; at Euston, 124·5°; and at Balranald, 125·5°, which is the nearest approach to the Bourke temperature. At Balranald, also, it is much colder in winter, having once fallen to 19·7°, which makes the extreme range there 105·8°—greater, therefore, than Bourke, and the nearest approach to that at Kiandra.

At Bourke the greatest variation of temperature in one day is 50°; at Wilcannia, 54°; at Walgett, 50°; at Deniliquin, 59°; at Forbes, 52°; at Dubbo, 49°; at Mudgee, 46°; at Bathurst, 47°; at Armidale, 43°; at Cooma, 53°; at Newcastle, 35°; at Sydney, 36.

It will be observed that the temperature range in one day gradually increases as we go southwards and away from the comparatively uniform temperature of the Tropics.

Average Monthly Temperature in the Shade.

The average monthly temperature in each square degree is shown in this map, and has been computed from all the available temperature observations in each degree.

The names of the months are given in the upper left-hand corner of the map, and are to be understood as applying to all the other squares in the same order.

In reading this chart it must be borne in mind that proximity to the sea and increased altitude reduce the temperature in the Rainfall Report of 1892. It is shown that a rise in altitude of 350 to 400 feet reduces the average temperature 1°, and in some cases 200 feet is enough to cause a fall in temperature of 1°.

Evaporation at Sydney.

Year.	Total from Earth.	Total from Water.	Total amount of Wind.	Total Rainfall.
	inches.	inches.	miles.	inches.
1885	21·549	30·024	83·477	39·908
1886	30·302	33·659	88·101	39·426
1887	31·877	33·358	91·785	60·164
1888	30·216	36·287	81·120	23·014
1889	25·390	34·368	81·652	57·158
1890	25·476	31·027	85·249	81·418
1891	26·952	32·085	81·688	55·302
1892	27·247	29·352	79·293	69·256
1893	25·430	31·128	81·217	49·901
1894	25·609	31·090	80·100	38·221
1895	26·378	33·537	86·978	31·856

Evaporation.

Average Monthly and Yearly Evaporation at Stations in N.S.W.

Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Wilcannia, 1891–1895 inclusive.												
8·960	7·683	6·267	3·341	2·308	1·526	1·761	2·807	4·066	5·951	7·282	8·524	60·477
Bourke, 1885–1887 inclusive.												
8·892	7·177	6·658	5·294	2·832	1·981	1·875	2·485	3·729	5·843	8·168	8·361	63·295
Walgett, 1886–1895 inclusive.												
8·427	6·613	6·421	3·893	2·665	1·920	1·991	2·799	3·725	5·522	7·297	8·638	59·962
Dubbo, 1888–1895 inclusive.												
9·668	8·892	6·728	3·713	2·081	1·662	1·523	2·027	2·807	4·440	6·862	8·896	59·299
Hay, 1886–1895 inclusive.												
6·237	4·820	4·212	2·708	1·462	1·322	1·140	1·663	2·422	3 784	4·806	5·807	40·383
Young, 1886–1895 inclusive.												
6·996	5·213	4·512	2·693	1·668	1·241	1·225	1·523	1·874	2·649	4·041	6·526	40·161
Lake George, 1890–1895 inclusive.												
4·084	3·115	2·607	1·821	1·173	0·908	0·744	1·125	1·803	2·963	3·496	4·234	28·072
Nepean Tunnel, 1888–1895 inclusive.												
4·439	3·472	3·126	2·259	1·584	1·337	1·327	1·739	2·450	3·538	4·008	4·880	34·159
Sydney, 1880–1895.												
4·685	3·712	3·163	2·380	1·698	1·431	1·514	1·868	2·516	3·449	4·060	4·970	35·446

Extremes of Evaporation in New South Wales.

Year.	Summer: Greatest in any one day.	Winter: Greatest in any one day.	Greatest in a month.	Summer: Greatest in any one day.	Winter: Greatest in any one day.	Greatest in a month.	Summer: Greatest in any one day.	Winter: Greatest in any one day.	Greatest in a month.
	WILCANNIA.			BOURKE.			WALGETT.		
1885	...	...	...	0·463	0·112	9·303	0·465	...	9·864
1886	...	...	...	0·600	0·257	9·080	0·561	0·179	9·296
1887	...	...	...	0·626	0·165	8·791	0·524	0·179	7·445
1888	...	...	...	...	...	...	0·567	0·133	10·614
1889	...	...	...	...	...	...	0·480	0·133	10·176
1890	...	...	...	...	...	...	0·734	0·140	8·146
1891	0·505	0·128	7·812	...	...	...	0·521	0·106	8·482
1892	0·578	0·087	9·142	...	...	...	0·471	0·115	9·150
1893	0·508	0·113	9·504	...	...	...	0·504	0·147	9·539
1894	0·498	0·167	9·042	...	...	...	0·468	0·078	8·329
1895	0·510	0·161	8·974	...	...	...	0·428	0·129	8·950
	DUBBO.			HAY.			YOUNG.		
1885	...	...	...	...	...	...	...	...	...
1886	...	...	...	0·304	0·155	6·068	0·476	0·154	8·903
1887	...	...	...	0·285	0·077	5·059	0·392	0·192	6·734
1888	0·496	0·096	9·799	0·390	0·162	6·435	0·397	0·087	6·956
1889	0·493	0·093	11·072	0·411	0·092	7·504	0·386	0·061	8·307
1890	0·482	0·090	9·768	0·435	0·071	8·100	0·386	0·087	7·232
1891	0·648	0·171	11·786	0·440	0·062	7·055	0·473	0·136	6·989
1892	0·680	0·069	14·421	0·378	0·078	6·389	0·532	0·097	7·055
1893	0·589	0·188	11·683	0·331	0·066	6·429	0·546	0·085	7·961
1894	0·493	0·092	9·317	0·329	0·104	6·261	0·363	0·161	6·472
1895	0·543	0·090	9·205	0·300	0·071	6·013	0·393	0·075	6·978
	LAKE GEORGE.			NEPEAN TUNNEL.			SYDNEY.		
1885	...	...	...	...	...	...	0·373	0·151	4·683
1886	...	...	...	...	...	...	0·312	0·086	5·223
1887	...	...	...	...	...	...	0·281	0·242	4·712
1888	...	...	...	0·365	0·104	4·968	0·287	0·096	5·020
1889	...	...	...	0·367	0·114	5·012	0·266	0·097	5·528
1890	0·326	0·053	5·594	0·366	0·161	5·223	0·333	0·121	5·587
1891	0·260	0·052	4·181	0·307	0·085	4·931	0·307	0·088	5·533
1882	0·217	0·062	4·038	0·282	0·116	4·937	0·323	0·079	4·910
1893	0·251	0·063	4·525	0·371	0·081	4·899	0·300	0·173	4·823
1894	0·207	0·055	3·864	0·275	0·077	4·519	0·308	0·106	4·890
1895	0·332	0·062	5·649	0·295	0·071	5·069	0·336	0·095	4·974

The following particulars, *re* the occurrence of frosts, may be of value to cultivators:—

METEOROLOGICAL Observations from Records kept at Sydney Observatory.

Frosts.

Stations.	Commence.	End.	Earliest.	Latest.
Albury	May	Middle of August	7 April, 1860	21 Sept., 1860
Antony	Beginning of June	Middle of August	16 May, 1882	20 Aug., 1888
Armidaie	Latter part of April	Middle of September	7 April, 1862	21 Dec., 1858
Bathurst	Beginning of May	Beginning of Sept	8 Feb., 1864	24 Oct., 1859
Bega	Middle of May	Middle of August	7 May, 1879	24 Aug., 1883
Bourke	Early in June	Latter part of July and beginning of August.	6 June, 1872 1881	2 Sept., 1889
Casino	June	July	Particulars meagre.	
Carcoar	Middle of April	Middle of October	9 Mar., 1881	30 Oct., 1886
Cooma	Middle of April	Beginning of Nov	3 ,, 1871	26 Nov., 1859
Coonabarabran	Latter part of April	Middle of October	19 ,, 1888	31 Oct., 1883
Cowra	Middle of May	Middle of August	3 May, 1886	26 Sept., 1885
Crookwell	Latter part of March	Latter part of Oct	15 Mar., 1886	30 Nov., 1885
Dubbo	Beginning of May	Middle of August	14 ,, 1885	11 Sept., 1875
Douglas (Lake George).	Middle of June	Middle of September	1 June, 1886	30 ,, 1886
Eden	No frosts at lighthouse.			
Forbes	Middle of June	August	25 May, 1874	† Sept., 1884
Glen Innes	Beginning of May	Middle of August	10 April, 1883	30 ,, 1885
Gosford	No frosts except in 1883, July 18th and August 4th.			
Goulburn	Middle of May	Latter part of Aug.	21 Mar., 1871	3 Oct., 1864
Grafton	June	July	14 May, 1887	18 Aug., 1886
Gulgong	May	September	6 ,, 1887	6 Oct., 1886
Gundaroo	Beginning of May	Latter part of Sept.	3 April, 1881	27 Nov., 1879
Gunnedah	Middle of June	Latter part of July	29 May, 1877	12 Sept., 1889
Guyra	Beginning of May	Middle of October	15 April, 1888	27 Nov,, 1886
Hay	Middle of June	Latter part of July	21 May, 1884	10 Aug., 1882
Inverell	Latter part of May	Middle of September	23 April, 1886	13 Oct., 1885
Kiandra	Frosts every month.			
Lismore	June	July	Particulars meagre.	
Maitland	Latter part of May	Latter part of July	2 May, 1860	16 Sept., 1860
Milton	Beginning of June	Beginning of August	25 ,, 1877	6 ,, 1881
Molong	Middle of May	Middle of September	5 ,, 1886	28 ,, 1887
Moruya Heads	Frosts during July, very light			
Moss Vale	Beginning of May	Middle of September	14 April, 1879 1888	21 Oct., 1888
Mudgee	Middle of May	Middle of September	13 ,, 1878	22 Sept., 1883
Murrumburrah	June	August	20 ,, *1887	24 Aug., 1889
Murrurundi	June	August	6 May, 1888	28 Sept., 1887
Muswellbrook	June	August	7 ,, 1888	9 ,, 1882
Narrabri	May	Beginning of Sept	8 ,, 1875	30 ,, 1874
Narrandera	June	August	3 ,, 1886	3 ,, 1889
Nowendoc	April	October	15 Mar., 1886	28 Oct., 1886
Orange	Middle of April	October	19 ,, 1888	2 Nov., 1882
Picton	May	September	24 April, 1888	14 Oct., 1887
Port Macquarie.	Frosts recorded only in 1874, 1880, 1888, June and July, very light.			
Queanbeyan	End of April	September	13 April, 1875	6 Nov., 1871
Quirindi	May	August	21 ,, 1887	19 Sept., 1884
Singleton	June	July	Particulars meagre.	
Scone	June	August	8 May, 1874	23 Sept., 1874
Tabulam	No frosts.			
Tamworth	May	September	24 April, 1886	29 Sept., 1884
Tenterfield	May	Beginning of Sept	1 May, 1879	13 ,, 1889
Urana	May	Middle of August	6 ,, 1879	21 Aug., 1879
Wagga Wagga	May	August	3 ,, 1879	7 Sept., 1881
Wentworth	June	August	15 ,, 1876	31 Aug., 1876
Wollongong	June 25th, 1877, only frost recorded.			
Young	May	August	20 April, 1887	25 Sept., 1886

* Very light. † No date given.

The Soil.

F. B. GUTHRIE.

The following remarks are an attempt to discuss in familiar and non-technical language the principles which underlie the scientific system of farming.

Other sections of this publication are to be consulted for detailed information in particular cases. This chapter is for those who wish to know something of the why and wherefore of things, who are not content to blindly follow instructions, either verbal or printed, but wish to gain some insight into the relations between soil and plant, and the general principles of cultivation and manuring.

Agriculture is an art, and it is an art that was practised centuries before the sciences were born with which it has become associated in modern times.

Man raised corn and made bread and wine thousands of years before he knew anything of the constituents of grain and grape, or the nature of fermentation, and a man can to-day be a thoroughly successful farmer without knowing anything about botany or pathology, or entomology or chemistry.

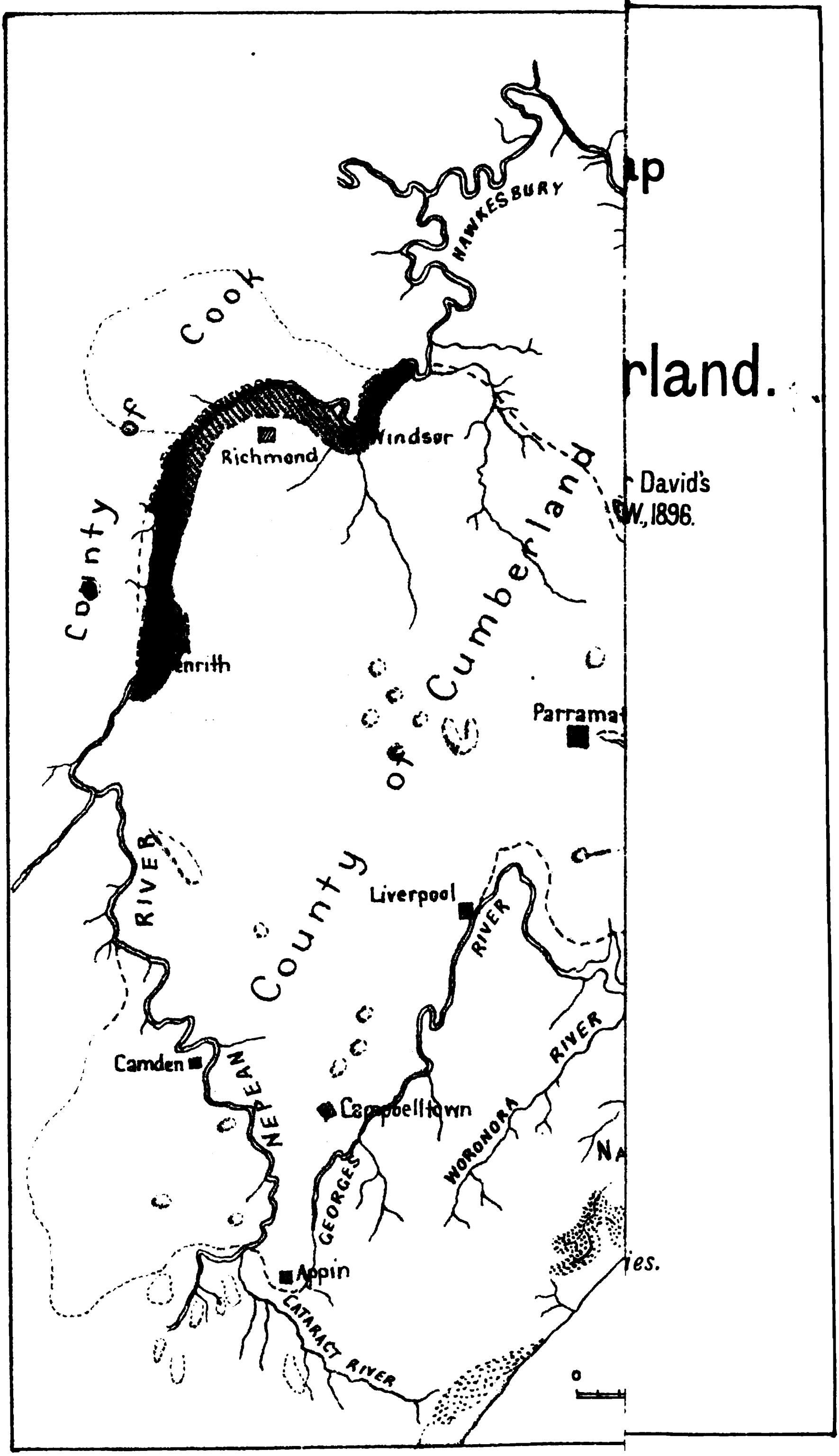
Indeed, it would be a very unfortunate state of things if a scientific education were a necessity to the farmer, for if agriculture could only be carried out by skilled men of science there would be very little farming done.

Nevertheless, the farmer of to-day, working under modern conditions, cannot afford to neglect the teachings of science as far as they affect his own art, and that farmer will be the successful one who is able to understand what science has to tell him, and to utilise the weapons which she puts into his hands.

And agriculture is indebted to science not only for the knowledge of useful facts and principles, but in a still higher degree for the scientific method of work, the spirit of inquiry, the patient, accurate, and systematic attention to the minutest detail. Without this, the farmer becomes a mere sowing and reaping machine, incapable of progress, and at the mercy of adverse seasons and crop diseases.

And the Australian farmer, above all, cannot afford to neglect assistance from whatever source it comes. He is at a great disadvantage in many respects in comparison with his brother husbandman in other parts of the world. He tills in many cases an infertile soil in an uncertain climate; he suffers, here from drought, there from floods, and occasionally from both alternately; he is handicapped by distance from market and by the high price of freight and labour. He works usually without much assistance from his neighbours, and loses much from want of mutual interchange of ideas and neighbourly co-operation.

With all these disadvantages, which apply more particularly to New South Wales (though I believe they are equally true for the rest of the continent of Australia), it becomes more than ever important for our farmers to avail themselves of every sort of information bearing upon their art, and to acquire some idea of the general principles which govern the growth of crops.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The days are past of the old rule of thumb methods of farming handed down from previous generations. We are entering into competition with other and more favoured countries in the markets of the world, and it is only by taking a leaf from their book, by studying their methods, by profiting by their experience and avoiding their mistakes that we can hope to succeed.

I have said that the soils of New South Wales are in many cases infertile. This remark requires some modification. Numberless examples of fertile areas will at once occur to the mind as exceptions to such a statement. The rich alluvial soils in the neighbourhood of the rivers, the deep fertile soils of volcanic origin met with in all parts in the New England district, and the rich pasture lands in the south are exceptions that will at once occur. But the bulk of the cultivated area of the Colony consists of poor soil. The soils of Cumberland and Camden, with which I am more closely acquainted, and which are derived from rocks of what is known as the Hawkesbury series, are by no means naturally fertile. They are as a rule but poorly supplied with plant-food, are either stiff clay or light sand, deficient in humus, and generally inclined to sourness, due generally to the fact that the surface soil is shallow and the subsoil a stiff clay.

In many cases the defects are easily remedied, and cultivation alone is sufficient to render them productive for the time being, but they are seldom of such a nature as to stand cropping in successive seasons without soon showing a considerable falling off. In order to understand exactly what this means I have calculated the average composition of over 130 soils from different parts of the county of Cumberland.

SOILS OF COUNTY CUMBERLAND.

The rocks which form the County of Cumberland belong to what is known as the Hawkesbury series. I shall divide, for purposes of comparison, the soils examined into two divisions, the first including those obtained from the area lying, roughly, between Sydney and Penrith, east and west, and the Kurrajong and Picton, north and south, which rest upon, and are for the most part derived from, Wianamatta shale, the second division including those from the rest of the County of Cumberland, derived principally from the Hawkesbury sandstone. Both the formations from which the Cumberland soils are derived are remarkably poor in constituents suitable for plant-food; it is consequently not to be expected that the derived soils should be rich in fertilising ingredients. Of the ingredients of which the Hawkesbury sandstone is composed, felspar is the only one whose disintegration provides any lime or potash, and we should expect to find very little phosphates, these salts being quite unrepresented in the original rock.

Geological Sketch-map.

The distribution of these formations is clearly shown in the accompanying map of County Cumberland, which was prepared by Mr. E. Dimelow, draughtsman to the Forestry Department, from a geological sketch-map published by Professor David to illustrate his Presidential Address to the Royal Society of New South Wales, 1896. My best thanks are due to Mr. Dimelow for the excellent map he has prepared, and to Professor David and the honorary secretaries of the Royal Society for permission to make use of the original.

Average Chemical Composition of Soils from County Cumberland.

The following table gives the average chemical composition of the soils from these two divisions, calculated from analyses of virgin soils about whose location there is no doubt. The analyses have all been made in the Laboratory of the Department during the last six years, a few having been made by Dr. A. Helms, and the remainder by my assistants, Mr. E. H. Gurney and Mr. Barker, and by myself. The numbers in the case of the mineral constituents represent the percentage amounts dissolved from the soil by concentrated hydrochloric acid, sp. gr. 1·1.

AVERAGE percentage of fertilising ingredients in Cumberland soils.

	Lime.	Potash.	Phosphoric acid.	Nitrogen.
Average of virgin soils from Wianamatta shale ...	·136	·133	·096	·140
Average of virgin soil from Hawkesbury sandstone	·106	·066	·137	·133
Average of all virgin soils from Cumberland ...	·121	·099	·116	·136

The most striking differences in the two divisions of soils are the much larger proportions of lime and potash, notably potash, in the shale soils and the larger amount of phosphoric acid in the sandstone soils. The slight difference in the nitrogen contents is not in reality due to the nature of the rock, this constituent varying with the amount of organic matter and humus present in the soil, which averages 7·62 in the shale soils and 7·22 in the sandstone ones.

It would be useless to try and trace any close connection between the composition of the soils themselves and the rock from which they have been derived. The chemical composition of a soil is determined less by the nature of its original rock than by the amount of decomposition which it has undergone.

The nitrogen represents the total nitrogen in the soil, of which it is safe to say that, under favourable conditions as to nitrification, it will ultimately all be in a form in which it can contribute towards the growth of the plant. The mineral ingredients, lime, potash, and phosphoric acid, are determined by extracting the soil with strong hydrochloric acid (1·1 sp. gr.). These numbers fairly represent the amount of these constituents which can be utilised as plant-food, and serve well for purposes of comparison with other soils. They do not, however, represent the amount of fertilising constituents immediately available to the crop. This could only be ascertained if we knew the nature of the crop in the first place, and in the second its power of assimilating plant-food.

In the following table the amount of plant-food in the Cumberland soils is compared with that in soils from other places :—

	Average of 130 Cumberland soils.	Average of 6 Fiji soils.	Soils from Island in South Pacific.	Average of "Laterite" soil from Selangor Malaya.	[*] Average of 300 Minnesota soils.	[†] Average of 34 Michigan soils.	[‡] Heavy clay pasture soil, Surrey, England.
Lime	·12	1·34	3·45	·10	2·17	·98	8·58
Potash... ...	·10	·27	·17	·12	·29	1·18	·20
Phosphoric acid	·12	·30	·12	·15	·25	·25	·05
Nitrogen ...	·14	·18	·26	·64	......	·12	·15

[*] Snyder. Bull. 41, Agric. Expt. Station, Minnesota. [†] Report on Michigan soils, R. C. Kedzie.
[‡] From Prof. P. F. Frankland's "Agricultural Analysis."

The above comparisons show that, at all events as far as the soils of Cumberland are concerned, they are poorly supplied with plant-food, the principal defects being the want of lime and potash. At the same time, it must not be forgotten that the actual quantities of fertilising ingredients are not an absolute measure of the soil's fertility, and any judgment founded on this characteristic alone would be misleading. The fertility of the soil depends only partly on the amount of plant-food (potash, lime, phosphoric acid, and nitrogen), and partly on the power the soil possesses of making use of these compounds. We have to take into account the other characteristics which conduce to fertility, especially the power possessed by the soil of changing the condition of the plant-food.

The soil is not an inert mass of material, out of which the plant picks whatever material is present for its nourishment, and, having exhausted that, dies. When we talk of changes that take place in the soil, we must realize that the changes are constantly going on, that the material of which the soil is composed is continually changing, that the growth and decay of plants, the movements of underground animals and of minute organisms, the fall of rain, the evaporation of moisture, alternations of temperature, of night and day, of summer and winter, even alterations of atmospheric pressure, the passing of clouds, and countless other phenomena of which we take no heed, or whose action we do not yet fully understand, all these agencies produce an incessant series of changes within the soil. When we add to these the changes produced by human agencies—by cultivation, by ploughing, liming, manuring, &c., &c.—it will be seen at once that a mere statement of the amount of fertilising material in the soil, even if we could say how much was actually available for any particular crop, is not all that is wanted if we are to judge of the soil's fertility.

FACTORS WHICH DETERMINE FERTILITY.

The fertility of a soil depends then, in the first place, upon the presence of a sufficiency of plant-food, and, secondly, upon certain physical characteristics, possessed more or less by all soils, which effect the splitting up of the mineral ingredients and nitrogenous matter in such a way as to render them available to plants, as well as regulating the supply of water, air, warmth, &c.

Of these physical characteritics, the most important is the—

Porosity of the soil.—On this characteristic depend a large number of the properties conducive to fertility.

By the porosity of the soil is meant the fineness and number of its pores. We must distinguish between this and permeability to water; a coarse sand, for example, being permeable to water, but possessing properties exactly opposed to those of a porous soil. Humus soils are especially porous. On the fineness of texture depend the following characteristics:—

The capillary power, by which is understood the power of imbibing water. This property maintains a continual circulation of water within the soil, and consequent aëration. It is, moreover, largely through the agency of this circulating water, which is charged with carbonic acid and different salts, that the mineral and, in a less degree, the organic matter of the soil is rendered available for plant-food and presented in solution to the plant.

The capillary power of a soil depends very largely upon the fineness of its texture. The nearer the texture approaches that of a sponge the greater will be its capillarity.

Humus has a very high capillary power, which is not possessed to any extent by either coarse sand or clay.

The capacity of the soil for water is also of special interest, and depends partly upon its porosity and partly on its content of organic matter. Peaty and humus soils, other things being equal, have the highest capacity for water, followed in order by marls, clays, loams, and sand.

The hygroscopic power—that is, the power of attracting water vapour—is of practical importance, in that it prevents undue evaporation, and prevents the soil from becoming parched up. It is also serves as a guide to the absorptive power for other gases. This property, like capillarity, is due entirely to the fineness of texture, and the order is the same—humus, clay, loam, marl, sand, and coarse sand.

The absorptive power of the soil for salts is a factor of very great importance in determining the fertility of a soil.

This power which soils possess of removing saline matter from solution, and retaining it within their pores, is due partly to the chemical nature of the soil, resulting in a chemical interchange of basic constituents, and partly to its mechanical structure, the fineness of its texture, substances such as humus and clay possessing the power in a remarkable degree.

Nitrification.

We now come to the most important property possessed by soils as affecting their fertility, and, at the same time, the most obscure, namely, their power of nitrification. This property depends upon a number of points, on some of which our information is not very clear.

From what we know of the process of nitrification, we can lay down with tolerable certainty the following conditions as being favourable to the process:—

We must have free access of air and moisture, a certain degree of warmth, the presence of nitrogenous organic matter, prone to oxidation (represented by humus). The presence of reducible mineral matter, such as sesquioxide of iron or metallic sulphates, is also favourable. A sufficiency of basic substances to combine with the nitric acid appears also to be advantageous to nitrification.

Putting on one side the bacteriological aspect of the phenomena involved, we shall find that the formation of nitrates within the soil is due to oxidation, and that within certain limits the power of oxidation which the soil possesses is also the measure of its nitrifying power.

We are, therefore, justified in assuming that a soil will be most favourable to the development of the nitric ferment which combines the following characteristics:—

1st. A fair proportion of humus.
2nd. A warm climate.
3rd. Provision for free access of air and of moisture (these depend upon its porosity, and are determined by its capillary power).
4th. Good drainage, to prevent stagnant water accumulating.
5th. A certain proportion of basic substances.

It will be seen that, beyond the presence of certain mineral and organic matter, the conditions favourable to nitrification are those whose presence otherwise indicates fertility—namely, fineness of texture and absence of excessive water. If the capillary power of a soil is low, it indicates an unfavourable condition for nitrification.

It has recently been stated by a French writer that the presence of nitrates in the soil assists in rendering soluble the potash in such insoluble combinations as felspar, which is an additional mode by which the nitric organism promotes fertility.

Provided, then, that the condition of the soil, as indicated by the physical properties above enumerated, is favourable to the metabolism of plant food, its fertility will depend upon the amount of that plant food, and it is immaterial whether that food be now in a soluble state or not. If the mineral and nitrogenous matter are present in sufficient quantity, and the soil possesses high absorptive capacity, high capillary powers—in short, is of good texture, and possesses the conditions conducive to nitrification—it may, I think, be fairly expected to prove a fertile soil; and in cases where one or more of the conditions conducive to fertility are absent, we may look to improved methods of cultivation to attain that fertility.

The above considerations lead us to attach special importance to two factors in particular besides the chemical nature of the soil. One factor is the texture of the soil, its porosity, and the second is the amount of humus or decaying organic matter it contains.

It may be worth while to study these two points a little more in detail.

Texture of Soil.

We have seen that the texture is of first importance in determining the fertility of the soil. We will now discuss some of the conditions which affect the texture and some of the means to be adopted to promote the desired porosity of texture.

Relation of Texture to Moisture.

The ideal condition of the soil as regards moisture is obtained when the soil contains about half the amount of water which it is capable of holding.

For example, a fairly heavy clay soil will have on the average a capacity for water of about 40 per cent.—that is to say, 100 lb. of such soil will absorb, when fully saturated with moisture, about 40 lb. of water. It is generally agreed that the amount of moisture most favourable to plant growth is something under half this amount, namely, about 18 per cent. If a much larger proportion of water exists than this, the interstices of the soil are filled with water instead of air, consequently there is a deficiency of oxygen which we have seen is one of the prime agents in promoting chemical action within the soil. The soil becomes what is called waterlogged and the chemical action which we have recognised as essential to fertility is at a standstill. The roots of the plants moreover are immersed in water.

The condition of things in a soil containing the proper amount of water, and in good tilth, is pretty much as follows: The minute grains of which the soil is composed do not form a compact mass, but the intervening spaces are so small that they act as capillary tubes, of the same nature as the pores of a sponge or the little tubes of an ordinary wick, and their effect upon the water present is exactly the same as the bundles of hollow tubes in the wick—that is to say, they draw the water up by the attraction of the sides of the tubes. Each grain of the soil will be then surrounded by a thin film of water which in its turn encloses and surrounds small bubbles of air. (In the case of a waterlogged soil, these bubbles are driven out, and there is little or no air in the soil.) In and out amongst the grains of soil the plant pushes its roots and its root-hairs in search of food and moisture. If the above rough description is at all clear it is obvious that the water in the soil is *continuous*—that is to say, a sufficiently minute organism could pass through the entire soil in the water, without ever having to touch a particle of soil, or pass through a bubble of air. The result of this is that supposing a particle of water to be removed at any point, either by evaporation at the surface or by absorption by means of the root-hairs, its place is at once taken by adjacent water, and the whole of the water in the soil is at once set in motion until equilibrium is again restored. It follows from this that a crop with well-developed roots is itself an important factor in retaining moisture within the soil, for, as the water is absorbed by the root-hairs at any point and circulates through the plant, its place is taken by adjacent particles of water so that a steady flow of water is set up towards that point.

The evil effects of too much moisture, which cannot get away, have been already mentioned. In addition is to be noted that this is one of the most common causes of sourness in the soil. Sourness—that is, the formation of certain acids within the soil—is directly due to the absence of air and oxygen, and can be remedied by the free admission of air, as by turning over and exposing to the atmosphere.

To prevent this accumulation of water, the remedy is to drain. In many cases where it is due to the presence of a stiff clay subsoil, through which the water cannot penetrate, subsoiling is resorted to; but it is also possible to have too little water in the soil, with the result that the crops wither and die, and this takes place when the evaporation equals or exceeds the absorption by the roots. Plants absorb water only through their roots and root-hairs.

The soil-water evaporates in two ways. The water absorbed by the root diffuses throughout the cell-system of stems and leaves, and evaporates through the breathing-pores of the leaf. Water is also lost by evaporation from the surface of the soil.

Both kinds of evaporation are increased by high temperature, dryness of the atmosphere, or a high wind—that is to say, evaporation is most rapid in hot, dry weather and a windy day; it is slowest in cool, moist weather and calm air.

The advantage of shelter in the shape of trees is therefore quite obvious as a means of cooling and moistening the air and breaking its force, and thus preventing too rapid evaporation. Quite obvious, but universally ignored in New South Wales, where every tree is religiously "cleared," and the crops protect themselves against drought as best they can.

I do not know of any other method for checking the evaporation from the leaves which has been successful, though one or two have been suggested.

With regard to the evaporation from the surface soil, the case is different. Evaporation from the surface can be checked by mulching. A covering of leaves or farm-yard manure, or any other form of mulch protects the surface soil from the heat and the dry winds which cause rapid evaporation, and prevent the too great loss of moisture; or the same result can be obtained by hoeing or stirring the surface-soil, which has the effect of breaking or widening the capillary tubes at the surface, and by this means preventing the upward motion of the water, for a time at least, and until the water has found out the new channels. Hoeing, therefore, which is generally practised for the removal of weeds, has another equally beneficial action, and it should be done even where there are no weeds.

The above remarks show how important a matter is the texture of a soil in its relation to moisture, the ideal soil being one of a fine tilth, from which excessive moisture readily drains away, in which there is free movement of air and water, and in which too rapid surface evaporation is checked.

HUMUS.

CLOSELY connected with the soil's texture and its consequent relation to moisture is its content of humus. Humus is the black or brownish matter in the soil produced by the slow decay of organic matter, whether of animal or vegetable origin. It is not a chemical compound, but a mixture of a number of different compounds, the nature of which varies both with the original matter and with the age of the product.

Relation of Humus to Moisture.

The presence of humus in the soil is beneficial in two ways; firstly, in improving the texture of the soil, and consequently its power of retaining water; and secondly, in its chemical action. The presence of humus in the surface soil acts as a kind of mulch, preventing undue surface evaporation, so that soils rich in humus are relatively moister than those poor in humus, and the evaporation from the surface is much slower. In sandy soils the presence of humus is of especial benefit. In clay soils, the fine clay to some extent produces the mechanical effects of humus.

Such soils are usually warmer than soils deficient in humus; firstly, because of the warmth produced by the continual slow decomposition of the humus itself, and also because of their dark colour, which absorbs heat and does not readily part with it.

Chemical action of Humus.

Humus is, however, not merely a mechanical ingredient of the soil, its presence induces chemical action which is of considerable benefit. It has, in the first place, a high absorptive power for ammonia, and is, in consequence, almost invariably nitrogenous, even though obtained from substances devoid of nitrogen. In other words it may be said to fix nitrogen.

It also forms with the bases present in the soil, such as lime, potash, &c., a class of substance known as humates, which are in a very much more soluble condition than the original compounds. Thus the addition of farm-yard manure not only supplies the land with the lime, potash, &c., which are contained in the manure itself, but the decomposition of the organic matter changes a part of the fertilising ingredients present in the soil in an insoluble condition into more available forms. We have also seen that a fair proportion of humus is conducive, indeed necessary, to nitrification.

Enough has been said to show the extreme value of humus as a soil-ingredient. Where it is deficient, as is too often the case in our soils, it should be supplied, either by means of liberal dressings of farm-yard manure and litter, or by green-manuring, which latter method is beneficial in other respects. [*See* remarks on green-manuring, page 54.]

The compost-heap, which should be found on every farm, is a further means of supplying this important ingredient. This matter is dealt with somewhat more fully in another place (page 59).

DRAINAGE.

THE subject of drainage has been well and practically dealt with in an article written for the *Gazette* in 1894 by Mr. G. McMinn, C.E., and with his permission the article in question is here reprinted.

The importance of a good system of draining cannot well be over-estimated, and the methods above suggested for the maintaining of a good mechanical condition of the soil will be ineffectual if the land is badly drained.

It is presupposed that the land is drained either naturally or artificially, otherwise it is impossible to keep it in good tilth.

Speaking generally the object of drainage is to remove surplus water from the land, and to assist aëration.

Of the more particular benefits derived from drainage, drained soils are generally warmer than undrained. In a well-drained soil, rain-water passes through, bringing air after it and thus aërating the soil, and also directly fertilising the soil with the fertilising material which it contains.

Undrained lands are liable to become sour and to get into bad mechanical condition. If the land is irrigated drainage is essential.

The following is the text of Mr. McMinn's article:—

Why we should Drain.

"Considering the number of persons who, from time to time, have taken up the occupation of cultivating the soil, it is remarkable how few have given serious attention to that really most important matter, the underdrainage of their land. During the last few years, many, for want of other outlet for their capital and energies, have, without much previous knowledge, gone extensively into orchard and vineyard culture; and it is those more particularly that I would address in this article, although the remarks will apply equally well to those engaged in raising cereal or root crops. In fact, I may say there is no class of cultivation that is not benefited by good drainage.

"Numerous able and very explicit articles on the subject "How to Drain," have frequently appeared in the various public prints devoted to agricultural matters, containing information of great value to those who were already convinced of the value and great benefits to be derived from well-drained land; but I have rarely seen any articles on "Why we should Drain," and it will be my endeavour, in as clear and concise a form as possible, to try and impress those who have not given much attention to the matter, with the great importance of the subject.

"I may say that, having had very considerable experience in carrying out some of the most extensive drainage schemes in Australia, including areas of some hundreds of miles in extent, and having seen the marked benefits following such work—transforming worthless swamps where, previously, only noxious reptiles and wild fowl found a home, into waving cornfields and prosperous homesteads—it may be allowed that I can speak with some authority upon the subject.

"In the first place, I would say that I do not agree with some writers who hold that all lands want draining. Some are so naturally drained by having a subsoil of such a porous character that water sinks in them by gravitation quite readily enough. It would be just as easy to take the 'breeks off a Highland man' as to take water from such land by means of artificial drains. Rather, what such land requires is for the surface to be kept in as fine a tilth as possible to prevent evaporation. But on the other hand, we have very large areas of clay land more or less heavy—land, in fact, that with only a moderate rainfall will, in a short space of time, becomes supersaturated with water which cannot escape in any other way than by evaporation or flowing over the surface, either of which is most objectionable.

"In conversation with many cultivators, I have ascertained that they had an idea that because our climate was at times very dry, there was no great need for drainage. Nothing could be more erroneous, for it has been found, by long experience, that for the proper disintegration of the soil so as to allow the plant-roots to penetrate to a depth to obtain a necessary supply of food and remain in a healthy condition, that an effective system of underdrainage is absolutely necessary; as also, by this means, to get rid of all superfluous water in as speedy a manner as possible. Underdrainage has the effect of making the soil much more friable and mellow, and the working of it becomes a pleasure instead of an irksome toil, as is often the case. Indeed, I have seen many undrained places where the soil had become so packed after heavy rains, that the labour of cultivating it was almost as great as it was to break it up in the first instance. Then again, land that is drained can be operated upon in a very short time, even after the heaviest rain, whereas weeks will sometimes elapse on undrained land before any work can be done, and during which time the water lying in the ground is doing very serious mischief, especially where orchards and vineyards are concerned, for the young rootlets, which should be always growing and gathering nourishment for the tree, will be completely destroyed by rot, and the result is seen by a paucity of foliage or an inferior and deficient fruit-crop; and the majority of the young wood-sprays, that should be developing to carry the next year's crop, die off. The health of the tree is impaired, and, unless remedial measures are speedily taken, it soon dies a victim to cold and wet.

"Throughout the Colony thousands of trees are annually lost in this way. Neither do trees ever attain their full size on undrained land, even where its demands are not great; consequently one must never expect to get the best obtainable returns without drainage. Then, for comparison sake, visit an orchard that has been intelligently treated in the matter of drainage. See the luxuriant growth, the wide-spreading nature of the trees, and, above all, in due season, the large crop and fine development of luscious fruit, and conviction as to what is necessary to be done will speedily follow.

"Underdrainage prevents water running over the surface, and causes all surplus rain to find its way to the drains through the soil, thus adding fertility to it; whereas, were the water to flow over the surface, an immense amount of fertilising matter would be carried away—much more than is generally supposed. Thus on drained land heavy rain is a blessing instead of a curse. By drainage the soil is kept warmer and drier, and the best conditions for plant growth are obtained. It also helps in no small degree to resist the effect of the dry seasons that we are liable to, for it puts the soil in that loose, mellow condition that enables it to hold more water without at any time having too much; and further, the healthful condition of a well-drained farm will be much greater than where it is otherwise. Consequently drainage confers an inestimable boon upon the residents of the farm, as well as upon the trees on the land. There are many, very many, reasons that could be given in favour of drainage did space allow; but this I will say, in concluding under this heading, that I firmly believe that everyone who cultivates the soil can double the producing power of his land by it, not only in quantity but also in quality; and, as to quality, it will, I am sure, be freely admitted that there is ample room for its improvement, for, as far as my experience goes, we do not at the present time produce sufficient really first-class fruit for our own market. Until we turn the thousands of tons of second and third-class fruit that annually crowds our markets into a first-class article it will be useless for us to think of exporting to any great extent; and I say confidently that this change will never be effected while drainage is neglected.

How we should Drain.

"In dealing with this part of the subject there will be several points to consider—the nature of the soil, the kind and size of drains, the quantity of water that it will be necessary to carry off in a certain time, distance apart of drains, best mode of laying them, &c., &c.

"Where the soil is of a clay nature I would not advise sinking the drains to a greater depth than 2 feet 6 inches. Below that depth it will be found as a rule that the clay becomes very compact and impervious to water, so that were the drain laid deeper it would not be fully effectual, and I do not think in this sort of soil that they should be more than 20 feet apart. In soils of a more friable and open nature it may be necessary to put the drains much deeper, but then not so many of them will be required.

"As to the kind of drain to be used, I think it will be admitted by all who have any experience in this work that there is nothing to beat the well-burnt earthen pipe, or, as it is commonly called, the tile drain. Of course where stone can be obtained readily and cheaply, and economy a necessity, good useful drains may be constructed by breaking the stone to about a 4-inch gauge and putting 9 or 10 inches in the bottom; but it must be remembered that with such drains there is always a liability to silt up and become inoperative, when all the work will have to be done over again; whereas with well-made and well-burnt pipe drains there is no limit to their duration.

"It is most important that the drains should have a sufficient capacity to carry off the surplus water in as short a time as possible, and to this end careful calculations will have to be made. It has not been an uncommon practice in determining the size of drains to calculate for the average annual rainfall, but a moment's thought will show that this plan would only answer in a country with a very even rainfall. But here, where at times we are subject to lengthy periods of drought, and at others to phenomenal falls of rain, it will be necessary to make provision for the latter, so that as short a time as possible may elapse between the fall of the rain and the surplus being cleared off the land. This is one of the points that requires good attention, for it does not take stagnant water long to do a great deal of mischief. Formerly, and still to some extent, very small pipes were used for laterals, but the tendency of late years has been, and I think wisely, to increase their size. I would not advise anyone to lay down anything less than a 2-inch lateral, and of course the size of main drains will have to be regulated by the number of laterals connecting with them, which in turn will be determined by the area to be operated upon. By all means have the drains too large rather than too small.

"How the drains should be laid: This part of the business requires the greatest care, for upon the pipes being well and truly laid depends the success or failure of the whole scheme. The ground to be drained should, in the first instance, be carefully surveyed, the lowest points ascertained, and the lines for the main drains marked off, after which it is an easy matter to range out the lines for the laterals. Then if it is possible to use a plough the top foot of the excavation may be opened by this means, not much labour being required to throw the loose earth slightly to one side, after which the remaining depth must be removed by manual labour, using spades suitable to the work; and it is in digging this lower portion that great care is necessary so as to get an even grade in the bottom, otherwise a good deal of extra labour will have to be expended in obtaining it. A true grade for the pipes to lie on is of the first importance. Should there be any hollows in which water would lie you may be sure the tree roots will find them out. The roots will enter the drain joints, continue to grow, and eventually choke it. This is a point that too much stress cannot be laid upon. With regard to the actual work connected with draining I would advise anyone in the first instance to procure a complete set of suitable tools. These will not be found to run into much money. By doing this the work will be much expedited and labour economised. When the pipes are laid about 6 inches of clay should be laid over them. This should be firmly and carefully trodden down, after which the remainder may be filled in by any sort of labour. Possibly using the plough will be found the most expeditious plan of turning the soil back.

"Every area to be drained will have its own peculiarities, and it is only by a complete and detailed study of each individual case that anyone will be able to arrive at what is the best and most economical course to be pursued; and I would strongly advise anyone who contemplates draining to any extent, if he has not had any previous experience, to consult some one qualified to advise on the subject. By so doing a good deal will be saved both in vexation and cost. The work will be reliable, and a little outlay in this respect will be found a great gain in the end. I would say to any intending orchardist, by all means in the first place drain your land, for by this the great cost often incurred in trenching may be saved. Of course, if one can afford to drain and trench as well, possibly so much the better, but I am of opinion that land broken up with a heavy plough to a depth of 14 inches, and thoroughly under-drained, is sufficient for all purposes. The drains will cause the bottom soil to disintegrate sufficiently for the roots to penetrate; and I would point out that trenched land without under-drainage is really a great deal worse than were it not trenched at all, for it only aggravates the evil by being in a condition to hold an immense quantity more water that has no possible chance of getting away.

When we should Drain.

"As to when we should drain I would recommend starting the work, if possible, early in the autumn, after the first rains have fallen, making the ground sufficiently soft to allow of easy and economical working, rather than leave it later in the year, when the ground becomes saturated and sloppy to work; and it will be found when growing plantations are to be operated upon, if done early in the year, that a very marked difference will take place in the next season's results. In many cases it will be found that the extra yields, both in quantity and quality, will be sufficient to pay for the whole cost of the drainage.

"Finally, I would say, and say it advisedly, that thorough drainage is the beginning and end of all successful cultivation. It is the keystone of the whole structure. Without it you may cultivate, manure, spray—in fact, do everything on the surface in the most perfect manner possible, but without thorough drainage you will never reap a full and adequate return for your labour and expenditure."

In all the foregoing remarks, special stress has been laid on the fact that the fertility of a soil is dependent not alone upon its chemical nature and the quantity of plant-food present, but also upon its mechanical condition, especially upon its texture, on which depend the free movement of air and moisture and the power of presenting these chemical ingredients in a form suitable for plant-food. The question of tilth becomes, therefore, a matter of the first importance, especially in a climate like our own, hot and prone to drought.

Thorough cultivation, good draining, the addition of lime, and green-manuring, are amongst the methods of improving the soil's texture and its consequent fertility that are of most benefit.

The object of manuring, on the other hand, should not be to improve the soil either temporarily or permanently; the object of manuring is to supply the growing crop with food. Manure the crop and not the soil.

The greatest benefit from manuring will be obtained on land which has been brought into good condition by the methods mentioned above.

We are now in a better position to discuss the general principles which underlie the question of the proper treatment of manures.

Manures and Manuring.

F. B. GUTHRIE.

HAVING discussed the nature and general peculiarities of the soil, we shall proceed to study the food-requirements of the different crops, and see in how far they are supplied by the soil and how far they require the assistance of manure. Like the foregoing, this subject is also one that is exceedingly difficult to treat of without introducing technicalities, and I must claim indulgence for any shortcomings.

THE CHEMICAL COMPOSITION OF THE PLANT.

I SHALL endeavour to deal with this subject as broadly and generally as possible, so as to avoid technical language and only bring into prominence those essential points which will enable us to understand the connection between the chemical requirements of the plants and the part played by the soil and manures for their provision.

We shall not go far wrong if we assume that all plants are built up of the same elements combined together in different proportions. They are carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, silicon, chlorine, and about half a dozen metals in combination. It is in the relative proportion of these elements and their compounds to which the great differences in the chemical composition of the various plants are due.

Different combinations of carbon, hydrogen, and oxygen give us the large class of bodies known as carbo-hydrates, including such dissimilar substances as starch, sugar, the woody structure, cellulose, gum, &c. Hydrogen and oxygen combined give us water; nitrogen, united with the above elements and sulphur, forms the nitrogenous constituents of the plant, such as the gluten in wheat. On the little that is known as to the formation of these substances in the living plant I do not here propose to dwell. Even less is known of the metals—their disposition in the plant, and the changes they undergo. We are able to detect their presence in the ash, in combination with oxygen, phosphorus, sulphur, and chlorine. The ash is that part which remains after the plant is burnt.

Now, not only do the quantities of the different elements vary in different plants, but in the same plant some elements are present in quantities out of all proportion to the others. Over one-half of the bulk of most growing plants consists of water. In watery fruit, such as the melon or cucumber, the percentage of water is as high as 90 to 96. Of the remaining portion of the plant the compounds of the metals rarely exceed 2 per cent., and are more often about 1 per cent. This you may readily prove by burning a weighed quantity of any green crop until a white ash, or nearly so, is left. The ash from every pound of such crop will not weigh more than 100 grains.

The point of importance for us to keep in mind is that each of these plant-constituents is as necessary for the well-being, even for the existence, of the plant as any other, whether that constituent be present in large or small quantities. The substances found in the ash, though present in minute proportions, are as indispensable to the well-being of the plant as the elements found in larger quantities. Not only that, but if any single one of the ash-constituents is insufficiently supplied—if the potash is deficient or the iron—the plant likewise suffers, although the amount of such element does not in many cases amount to more than a fraction of 1 per cent.

Now, the volatile portion of the plant—that is, the water, carbo-hydrates, nitrogenous matter—are for the most part abundantly supplied to it by air and rain (with the exception of the nitrogen in some plants); that is to say, about 98 per cent. of the food of the entire plant is derived from air and water. From the soil it extracts the remaining 2 per cent., consisting of iron, lime, magnesia, potash, soda, and perhaps manganese, combined with sulphuric, hydrochloric, and phosphoric acids, together with the nitrogen as already stated. These substances it is the function of the soil to supply, and where the soil, by reason of its nature, or from having been exhausted, is unable to meet the demand, we have to assist it by means of manure.

The object, then, of manuring, is to assist the soil in presenting to the plant a portion of the food necessary for its growth; and though the food-stuff thus supplied is extremely minute in comparison with what the plant derives from other sources, it is nevertheless of the greatest importance, and its absence or insufficiency will affect the health of the plant quite as much as the absence of air or of sunlight or of water.

Ingredients to be supplemented by Manure.

Of these ash ingredients the greater portion is found in all soils in quantities more than sufficient for the requirements of any number of crops; thus, iron, magnesium, sodium, manganese, chlorine, sulphuric acid, silica are present in nearly all soils in greater quantities than the plant requires, so that there is little danger of the soil becoming exhausted as far as they are concerned. The ingredients, therefore, that we have to supplement by means of manure are reduced to three or four, viz., lime, potash, phosphoric acid, and nitrogen.

Lime is probably present in most soils in quantities sufficient for the purposes of plant-food, and it is seldom necessary to supply it with that object. Its principal functions when applied to land are, firstly, a mechanical one, in modifying the physical character of the soil; and, secondly, a chemical one, in rendering available certain insoluble plant-foods. Lime acts, however, also directly as a plant-food, and the different classes of artificial manures fall under one or other of the above headings, according as they supply lime, potash, phosphoric acid, or nitrogen.

The food thus supplied by the soil is taken up in solution by a peculiar process of suction by means of the roots. It is, therefore, necessary that such food should be in a soluble form to be of any use to the plant, which is unable to utilise insoluble material. By soluble we mean soluble in water or in the weak acids present in the soil or secreted by the plant-roots.

Insoluble and Soluble Plant-food.

This is what is meant by the mineral constituents being "available for plant-food," and when the terms "latent" or "dormant" and "active" are employed, they simply mean insoluble or soluble in the water imbibed by the root. Those manures which are known as quick-acting manures are such as contain their potash, phosphoric acid, and nitrogen in a soluble form at once available for the plant; those which are slow-acting contain these substances in a more or less insoluble condition.

In these latter cases a gradual decomposition takes place in the soil, due to the action of chemical agencies within the soil and assisted by the action of the roots of the plant, by which the insoluble compounds are converted into soluble ones, and so become gradually available, the beneficial action extending over a long period of time.

A good example of these two conditions is found in the state of the phosphoric acid in bone-meal and in superphosphate respectively. Bone-meal consists of bones ground to a powder, and the compound of phosphoric acid and lime which it contains is insoluble in water to any appreciable extent. In course of time the agencies at work in the soil render it soluble. Superphosphate is a compound manufactured by treating bones or mineral phosphates with strong oil of vitriol, by which treatment a different compound of phosphoric acid and lime is produced. This being readily soluble is at once made use of by the plant.

Dominant Ingredients.

From the preceding considerations, which I have endeavoured to make as clear and as general as possible without going into precise details, we shall have realised that a definite relationship exists between the requirements of the plant and the nature of the food with which we have to supply it. All plants do not take up the constituents presented by the soil in the same proportion, and are consequently benefited differently by different manures. No amount of nitrogenous manure will materially benefit the pea-crop, but a small quantity added to the land in which wheat is grown will produce a considerable increase in the yield. With all crops there is a special ingredient or ingredients which they require more than others. Some require potash, others nitrogen, whilst others do not thrive unless there is abundance of phosphoric acid.

What these special requirements are, and the nature of the different manures by means of which they are satisfied, we are now in a position to enquire into.

We know that in the selection of the proper manure for use in any special case we have, in the first place, to consider the requirements of the crop in question, and, secondly, in how far the soil can supply those requirements.

CROP REQUIREMENTS.

In connection with the rational application of artificial manures, we have, therefore, the following points to consider :—

1. What are the chemical requirements of the different crops?
2. In how far do our soils supply these requirements?
3. In what direction are they to be assisted by manure?

I do not propose to touch upon the question of tillage or of general farming operations, except in so far as they may produce chemical changes in the soil constituents. The action of the different manures will be regarded entirely from a chemical point of view as plant-food.

In the first place with regard to the requirements of the different cultivated crops. A very superficial observation is enough to show us that the food required by different plants must vary considerably. Plants vary enormously in character. Between the fruit of the different species there is an almost infinite variety. The nourishment that produces the sparse leafage of the cereals can obviously not be the same that is required for the leaf-masses of such crops as lucerne or cabbage. The differences are not in all cases so obvious; but we may safely say that every plant requires one or more special sorts of food, and exercises a power of selection in regard to such food. Some crops cannot make use of the soil-ingredients to the same extent that others do.

Some crops also occupy the ground for a longer period than others; those that come rapidly to maturity will require a larger store of food which is immediately available. Again, their requirements vary in many cases at different stages of their growth. What these special requirements are we will proceed to examine more in detail for each class of crop.

Cereals.

Wheat.—The quantities of the different fertilising ingredients removed from the soil by the wheat crop are as follows:—These, and similar figures with regard to other crops, are taken from Warington's Chemistry, and refer to English conditions.

If the figures here given as the average weight of the crop appear too large to our farmers, all I can say is that there is no reason why we should not produce crops of the same average weight. These crops are obtained by the proper and scientific application of manures on the lines I am advocating, and there is not the slightest reason to doubt that we can obtain the same results by the application of the same principles.

An average wheat crop of 30 bushels grain to the acre weighs about 5,000 lb., or something over 2 tons of grain and straw and removes from the soil during the period of its growth 48 lb. nitrogen, 21 lb. phosphoric acid, and 29 lb. potash.

The wheat crop depends practically entirely upon the soil for its nitrogen, so that for the whole of the above quantities of food the wheat is dependent upon the supplies existing in the soil. Now, 48 lb. nitrogen is equivalent roughly to about ·003 per cent., as indicated by analysis in a soil of average weight 6 inches deep. This quantity is very much less than the average percentage of nitrogen in our soils, which is quite ·1 per cent. That means that if the nitrogen in the soil were immediately available the poorest soil would contain abundance of it for a succession of several crops. But wheat does not appear to be capable of utilising the soil-nitrogen to its full extent, consequently the application of soluble nitrogenous manures is particularly beneficial to it and the other cereals. The same remarks apply to phosphoric acid and potash.

Twenty-one pounds phosphoric acid represents about ·001 per cent. phosphoric acid in a soil of average weight and depth. This quantity is present ten times over, even in poor soils, as is ·002 per cent. potash, the quantity represented by 29 lb. potash, required by the plant. If, then, it were possible to convert the plant-food in the soil into an available form at the times that the plant can make use of them the necessity for manuring of any sort would be done away with.

One reason why nitrogenous manures are particularly beneficial lies in the fact that the period of the active growth of the wheat-plant ceases before the period when nitrification is most active. During the summer and early autumn certain organisms are active within the soil, by the action of which the soil-nitrogen is converted into nitrates.

Nitrates are exceedingly soluble salts, and particularly adapted for supplying the wheat crop with nitrogen, but their formation commences after the crop has ceased its active growth, and they are washed away from the surface soil before the succeeding crop can make use of them.

Wheat thrives best in soils of moderate stiffness, and does better in a moist soil than most cereals. In a moist climate it is said to do better on a light than on a heavy soil.

It is a usual practice to grow a root crop, especially turnips, before wheat. During the growth of the turnip crop nitrogen is stored up in the soil, and the roots tap more especially the lower strata of the soil. Lime is an essential ingredient in wheat lands, but the manures which are especially beneficial are nitrogenous ones.

It is still an undecided question whether wheat absorbs its nitrogen in the form of ammonium salts or nitrates, but while the concensus of opinion points to the probability that it is in the form of ammonia that it actually enters the plant, yet it is generally admitted that nitrate of soda is the most effective form of manure. Sulphate of ammonia is, however, considerably cheaper with us, and on that account will be our most effective fertiliser.

The cheapest method of applying nitrogen to the soil is by means of what is known as green manuring. Leguminous crops, such as cow-pea or clover, have the power of utilising the nitrogen present in the air in a manner we shall go into more fully later on. When such a crop is allowed to grow until its period of active growth ceases—that is, until it flowers—and then ploughed in, not only are all the fertilising ingredients which it has abstracted from the soil returned to it, but the land is further enriched by an additional supply of nitrogen. The nitrogen in this form is not in such a soluble condition as the nitrogen in sulphate of ammonia, but the method is a cheap and effective one, and in cases where it can be conveniently applied will be found of great value in improving the land, for, in addition to the direct supply of nitrogen, the decay of the crop within the soil produces a store of humus, and exercises a solvent action upon the other soil-ingredients, hastening the natural decomposition of the soil, and benefiting it both chemically and mechanically.

The crops best suited for the purpose are such leguminous crops as mature quickly, and do not occupy the land for any length of time, and are otherwise of no great value as crops. This subject is more fully discussed in the chapter on manures, page 54.

Wheat occupies the ground for a very much longer period than other cereals, such as oats and barley, and removes rather a larger proportion of soil-constituents. It is, therefore, a somewhat exhausting crop.

The best manures for wheat in the soil of average quality is an autumn manuring of fine bone-dust and dried blood, about 3 cwt. per acre, followed by a top-dressing in the spring of a mixture of 2 cwt. superphosphate, and 1½ cwt. sulphate of ammonia per acre; or, instead, about 3 cwt. per acre of a good guano. This spring dressing it is best and most economical to apply in two portions, the first when the young plants begin to shoot, and the remainder at a somewhat later stage. If the above quantities are all applied at once a large proportion would not be immediately utilised, and would be washed away and lost. By applying it in two separate portions the fullest benefit is obtained.

Nitrogenous manure should not be applied at a late stage of the plant's growth.

On land rich in lime an autumn treatment of 2 cwt. superphosphate per acre is sometimes recommended instead of the bone-dust.

Do not use the nitrogenous manures in quantities much larger than those recommended above, as too much nitrogen is injurious, causing a tendency in the plants to become too green and to "lay"; but mineral manures alone are not of much benefit unless a sufficiency of nitrogenous matter be added.

Of the other cereals—

Maize prefers light porous sandy loams, and does not do so well upon stiff clay soils. It is a gross feeder, and needs heavy manuring.

Rye accommodates itself to lighter and drier soils—in fact, the poorest soil is usually considered good enough for rye. The presence of lime is not of so much importance as with wheat.

Barley requires a light fertile soil, warm and friable, and grows most strongly, and produces the largest crops on land well tilled and heavily manured. If, however, the grain is grown for malting purposes, the application of nitrogenous manures is to be avoided, as the grain produced by such treatment contains a large proportion of nitrogenous matter, which injures the keeping qualities of the beer, the starch in the grain being likewise diminished.

Oats thrive best in a damp climate and moist soil, with a moderate summer temperature. They contain considerably more potash in the straw than the other cereals.

The manuring recommended in the case of wheat applies more or less to all the cereals. They are all especially benefited by the application of nitrogenous manures.

The autumn manuring may consist of farm-yard manure, dried blood and bone-dust or superphosphate, with a spring top-dressing of superphosphate and sulphate of ammonia, to be applied in two portions, as already indicated.

Grass.

A crop of 1½ ton of meadow hay per acre contains on the average 49 lb. nitrogen, 51 lb. potash, and 12½ lb. phosphoric acid.

The question of the appropriate manuring of grass-lands is complicated by the question as to whether it is intended for permanent pasture or to be cut for hay, and whether grass or clover is to predominate. It may be stated generally that the proportion of clover is increased by the application of manures containing potash and phosphoric acid, and diminished by the application of nitrogenous manures.

Too heavy manuring of any kind, especially nitrogenous, tends to the growth of coarse grass. Manures containing lime, such as plaster, also promote the growth of clovers.

For grass the best results were obtained by Lawes and Gilbert by the application of mineral manures (superphosphate and kainit) together with sulphate of ammonia. Heavy grass-crops were obtained to the almost total exclusion of clover. To promote the growth of clovers, omit the ammonium salts from the above mixture, and manure with mineral fertilisers alone.

Stable manure and compost is an excellent manure for grass-lands, especially when mixed with sulphate of ammonia.

Root-crops

Exhibit a greater variety in their food requirements than the cereals, and differ more amongst themselves. In all cases the crops contain a larger proportion of nitrogen than the cereals, but they appear to possess to a far greater degree than these the power of assimilating the nitrogen as it exists in the soil; consequently the application of nitrogenous manure alone is, as a rule, without much benefit, the exception being the mangel crop, for which purely nitrogenous manures are distinctly beneficial. They all produce far more bulky crops than the cereals, and remove proportionately larger quantities of the soil ingredients. They, therefore, require liberal manuring, and are especially benefited by the application of potash.

Potatoes.—A crop of 6 tons potatoes weighs about 18,000 lb. of tubers and haulm, and removes from the soil 67 lb. nitrogen, 80 lb. potash, and 24 lb. phosphoric acid. As in the case of the cereals, these quantities are abundantly present in the poorest land, and it is only a question of the power of the crop to assimilate them. Potatoes do well in most soils, best in loose mellow soils. Virgin soil appears particularly well adapted to their growth. This may be partly due to the manuring of potash the soil receives from the clearing and burning away of the timber. The sub-soil should be porous, the tubers being liable to rot in land with stiff sub-soil, or in very retentive soils. The soils should not be too stiff otherwise there is not room for the roots to develope. They are surface feeders, and, as might be expected from the preponderance of potash in their composition, the application of potash manures is especially beneficial. Kainit is a very valuable manure for the potato crop, and plays much the same part in regard to it that nitrogenous manures doin the case of cereals. The addition of kainit alone is, however, not usually of much benefit, and it is generally applied together with superphosphate. Before sowing, the best treatment for average land is the following:—About 3 cwt. superphosphate, mixed with 2 cwt. kainit, and 1 cwt. sulphate of ammonia per acre.

Turnips.—A crop of 17 tons roots per acre contains 49,000 lb. of root and leaf, and removes from the soil 112 lb. nitrogen, 149 lb. potash, and 33 lb. phosphoric acid in round numbers. They thrive best on light loams, loose and open. The land for the turnip-crop requires more thorough tillage and previous preparation than for any other crop; but this question is outside the scope of the present discussion. They are a crop that requires heavy manuring, and a liberal dressing of farm-yard manure is essential to their successful cultivation. Though the quantity of potash is larger than in the potato crop, potash manures have not the same marked benefit. Their weak point appears to be their inability to make use of the phosphoric acid in the state in which it exists in the soil; hence the manures from which they derive especial benefit are those containing phosphoric acid, such as superphosphate or bone-dust; 3 cwt. to 4 cwt. superphosphate per acre is the average proportion.

Mangels.—A mangel crop of 22 tons weighs 67,000 lb. roots and leaves, and removes 147 lb. nitrogen, 300 lb. potash, and 53 lb. phosphoric acid. Mangels are deep feeders, and require a deep and well-tilled soil. They form an exception to most root crops in that they are capable of utilising the phosphoric acid and potash present in the soil, and the manures that specially benefit them are those containing nitrogen. On a rich land, or one already well manured with farm-yard manure, the application of a soluble nitrogenous manure alone is of marked benefit, though, as a rule, it is added together with superphosphates.

Beet-root is also a crop that requires nitrogenous manures in conjunction with bone-dust or superphosphate.

Leguminous Crops,

Comprising such crops as the pea, bean, lupin, lucerne, clover, vetches, &c., stand midway between the cereals and root-crops with regard to the amount of fertilising materials they contain. The following figures show the composition of beans and of red clover.

Beans.—A crop of 30 bushels grain consists of 2,000 lb. grain and 2,200 lb. straw, and contains 99 lb. nitrogen, 67 lb. potash, and 29 lb. phosphoric acid.

A *Red Clover* crop of 2 tons contains 102 lb. nitrogen, 83½ lb. potash, and 25 lb. phosphoric acid.

In addition to the above, leguminous crops contain a large proportion of lime, amounting in the clover crop to 90 lb. None of the cereals contain more than 10 lb. lime in the entire crop. Potatoes contain about 27; mangels, 43; and turnips, 70; so that it will be seen that the proportion of lime in the leguminous crops is considerable.

They thrive best on calcareous soils, and derive special benefit from the addition of lime as a manure.

But the most striking peculiarity about this class of plants lies in the fact that they can be practically independent of the soil for their supply of nitrogen. It has long been a vexed question, and is still undecided, whether plants are able to utilise the nitrogen of the air by means of their leaves. There is no satisfactory evidence hitherto of this fixation of nitrogen by the leaves of growing plants, and it is quite certain that the amount thus obtained is inconsiderable, and not sufficient to enable them to thrive independently of the soil-nitrogen.

The case of leguminous plants is, however, quite different, and exceedingly interesting. It appears from experiments of Hellriegel and Willfarth, and, later, of Lawes and Gilbert, on peas, lupins, vetches, and lucerne, that there exist in the root-nodules, or small excrescences on the roots of these plants, certain minute organisms which are capable of assimilating free nitrogen and of rendering it in an available form to the plant. These organisms act, therefore, as carriers of nitrogen between the air and the plant, and the root-nodules become a store-house from which the leguminous crop derives its nitrogenous food. The air from which the nitrogen is thus withdrawn is the air in the interstices of the soil, and as this is continually renewed, especially in the case of a porous soil, from the outside air, the supply of nitrogen is practically an inexhaustible one. The form and appearance of those nodules vary somewhat in the different plants, being generally large or small swellings on the root or root-fibres, sometimes single and sometimes agglomerated. It is generally believed that the soil-nitrogen is drawn upon in the first place, and that it is supplemented by the nitrogen obtained from the air by the above method of fixation. Though leguminous plants exhibit this peculiarity in a special degree, there is reason to believe that other plants are able to fix nitrogen from the air in a similar manner, though in a much smaller degree.

On account of this property possessed by leguminous plants, such plants derive little or no benefit from the application of nitrogenous manures—in fact, it has been observed that the formation of root-tubercles is reduced, or even stopped entirely, by the addition of much nitrate.

The manures that particularly benefit leguminous crops are such as contain potash. Taking further into account the proportion of lime necessary, the following would be found a useful average formula. A dressing of lime in the autumn, say 1 ton to 1½ tons per acre, followed by a top-dressing to the crop of 3 cwt. superphosphate and 2 cwt. kainit per acre.

Fruit-trees.

The proper manuring for these, together with the general treatment of the orchard, has been carefully gone into by Messrs. Benson and Allen in another part of this publication. It will therefore be unnecessary to discuss the subject in this place.

All fruits contain considerable proportions of potash and phosphoric acid, and of nitrogenous matter; moreover, the assimilation of nitrogen promotes the formation of sugar in the fruit, so that it may be generally said that a good general manuring containing lime, potash, phosphoric acid, and nitrogen is essential for the production of fruit in highest excellence, in addition to the mechanical treatment of the soil by effective draining, &c.

COMPOSITION AND ACTION OF MANURES.

We have now to consider the composition and the specific action of the several substances used as manures; and for this purpose it will be convenient to classify them according as lime, phosphoric acid, nitrogen, or potash is their dominant constituent.

Manures containing Lime.

The manures which depend for their action upon the presence of lime are burnt lime, carbonate of lime, and gypsum.

Burnt lime, stone-lime, or quicklime is obtained by burning limestone (carbonate of lime) in kilns of special construction. Limestone is a compound containing lime and carbonic acid. In the process of burning or calcining, carbonic acid and water are driven off, and the burnt product is pure lime (calcium oxide) of greater or less purity according to the purity of the original stone. Other substances having the same composition as limestone also yield lime on being burnt, such as chalk, marble, shells, &c. If the lime has been properly burnt it forms a very hard stony substance, nearly white, which slakes, or combines with water, with great avidity, crumbling to a fine white powder and evolving sufficient heat to convert a part of the water into steam. In slaking it combines with water, slaked lime being a hydrate of lime. As its function in the soil is principally mechanical, a test of its goodness lies in the readiness and completeness with which it slakes. Both under-burnt and over-burnt lime slake badly, though from different causes.

The quantity to be applied varies according to the character of the soil. Unlike most of the manurial substances we shall have to consider, its action consists in improving the character of the soil rather than in acting as a direct plant-food. It is applied in quantities varying from half-a-ton to 4 tons per acre every six or seven years, heavy clay lands requiring the larger dressing.

It is best to break it up into small lumps and place it in heaps about the field, covered with moist loam, leaving it exposed to the air and moisture for a short time—say about twenty-four hours—until it begins to crumble to powder. As soon as this happens, scatter the heaps with a shovel as evenly as possible over the surface of the field, and harrow or plough it in lightly. Liming is most effectively done in the autumn or winter; but whenever it is done the land should be left alone for quite three weeks after the application, and no seed should be sown nor any nitrogenous manure added during that period.

Action of Lime on Different Soils.

The action of lime is in the first place a mechanical one, in altering the texture of the soil, and with it those properties which depend upon its texture, such as its absorptive power for water, its amenability to tillage operations, &c.

The action of lime upon a clay soil may be illustrated by the following experiment. If a small quantity of a heavy clay be mixed with water in any suitable vessel it will form a muddy liquid. If a little lime be added to this and the mixture well shaken it will be noticed that the solid matters sink to the bottom in a loose powder, and, in a short space of time, if the water is poured off and the soil dried, it can be readily broken up by the fingers. If no lime had been previously added the clay, on drying, would form a hard mass difficult to break up. This action, which is due to the power that the lime has of coagulating the fine particles of the clay, is identical with what takes place on the larger scale when lime is added to the field.

The presence of lime also prevents the shrinkage which wet clay-soils undergo on drying, and which causes the cracks and fissures seen on the parched clay-soil. The admixture of lime to a clay, therefore, prevents the formation of a sticky mass when wet, and a cracked parched appearance when dry.

On light sandy soils the action of lime is also strikingly beneficial in binding the particles of sand together, and increasing the cohesive and capillary power of the soil. Its action is, in fact, exactly that of lime on sand in the mixing of mortars, only on a much modified scale, since for making mortar the proportions are one part of lime to three or four parts of sand, whereas the addition of a ton of lime per acre represents one part of lime to nearly 20,000 parts of sand. The action of the lime is the same in both cases: on drying it absorbs carbonic acid from the air, forming carbonate of lime, which cements the particles of sand together, forming, in the proportions used in making mortar, a hard compact mass, and in the case of the soil increasing its cohesiveness and its power of retaining water.

Lime, therefore, lessens the cohesiveness of clay soils, and increases that of sandy soils, two properties which are apparently opposed to one another. In fact, there are a few soils, the mechanical texture of which is not improved by the addition of lime.

The action of slaked lime is exactly the same as that of stone or quick lime, but not so pronounced, and it is generally preferable to use the lime unslaked, or only slightly slaked, as recommended above. Apart from the above mechanical property of lime in improving the texture of the soil, it has also a chemical action, and though this is not thoroughly understood, it may be classed under the following headings:—

Firstly, it neutralises the free acids sometimes present in soils. Sour soils contain free acids present in such quantity as to be injurious to plant-life, and such soils are "sweetened" by the application of lime, that is to say, the free humic and similar acids are neutralised.

Secondly, it attacks the inert organic matters in the soil and promotes fermentation, one of the most active agents in the production of available plant-food. It is, of course, possible to have too much of a good thing, and an excessive dressing of lime would tend to burn up the vegetable matter of the soil and do as much harm as good, but in the moderate dressings above recommended it will be found beneficial even on land which has lately been green-manured. It must not be forgotten, however, that the action due to caustic lime soon ceases, for it is very rapidly converted into carbonate of lime within the soil, which has no such action on organic matter.

Thirdly, it attacks the insoluble mineral constituents of the soil to some extent. This is notably the case with potash, which being a weaker base than lime is set free from its insoluble compounds, such as felspar, and rendered available as plant-food. Phosphoric acid also enters into combination with lime, and is in this form more readily utilised by the plant than in its insoluble combinations with iron and alumina, with which it is associated in the soil.

Owing to the tendency of lime to burn up a portion of the organic matter its benefit is more marked on soils rich in organic matter, and it is advisable to lime the soil before green-manuring, and not after.

Fourthly, carbonate of lime (into which we have seen the lime is soon converted in the soil) is beneficial, if not necessary, to the process of nitrification, the peculiar ferment action by which the inert soil-nitrogen is converted into nitrates.

Fifthly, whilst it promotes certain ferment action such as the above, it hinders the active growth of many fungoid diseases like rust and smut, and is said to be often a cure for such diseases.

Carbonate of lime, or, as it is sometimes called, "mild lime," is unburned limestone or shells crushed. Its addition to the soil promotes fermentation and nitrification, prevents clay lands from puddling, and in short has much the same action on the soil as lime has, except where such action depends upon the conversion of lime into carbonate. It is milder in its action, and, as a rule, burnt lime is to be preferred.

Gypsum or plaster is also a substance that may be sometimes used to advantage. Its action appears to consist almost solely in setting free potash, hence it is most useful on soils rich in potash, and for such crops as clover it is of especial service. It is best applied moist or in wet weather at the rate of 2 to 3 cwt. per acre. Gypsum is also often used as a "fixer," that is to say, when added to dung or urine or decaying animal and vegetable matter, it decomposes the carbonate of ammonia which is being continually evolved from such substances, and converts it into sulphate of ammonia, in which form ammonia does not escape into the air. If a heap of dung from which the odour of ammonia is perceptible be mixed with a few shovelfuls of moist gypsum, the smell will be found to have disappeared; in other words, the ammonia is "fixed," and its loss prevented.

Gypsum is also of great value in lands which are charged with alkali, or irrigated by alkaline water. For this purpose it is either sown on the land in proportions depending upon the amount of alkali in the soil, or it may be introduced in boxes in the irrigation-sluices, or added to the tanks if the water is stored.

Manures containing Phosphoric Acid.

Phosphoric acid is applied to the soil almost exclusively in the form of phosphate of lime, and its sources are bones, rock-phosphates, and guanos. In the apparent absence of any large quantities of phosphatic rocks in our continent, we are principally dependent for our supply of phosphate of lime on the bones of animals.

Bones and Bone-products.

Bones vary very slightly in composition from whatever source they are drawn, or from whatever part of the animal they are taken, though as a rule the thigh-bones and the bones that have to bear the greatest mechanical strain are the richest in phosphate of lime. Bones are composed chemically of water, ossein or collagen, fat, and mineral salts. The last-named, which are left behind as ash when the bones are burnt, consist principally of phosphate of lime. Bone-ash contains about 83 per cent. of this substance, together with about 10 per cent. carbonate of lime, and in much smaller quantities magnesium compounds, and fluoride and chloride of calcium.

The ossein of the bones is the substance which is converted into gelatine by boiling with water, and is an albuminoid containing about 16 per cent. nitrogen. Bones are, therefore, a nitrogenous, as well as a phosphatic manure. An average sample reduced to powder as bone-meal, contains about 45 per cent. phosphate of lime, and a trifle under 4 per cent. nitrogen.

Bones are used in a variety of ways. They may be used whole or broken, or reduced to powder (as bone-meal, bone-dust, or ground bones), they may be boiled or steamed, or fermented; calcined (bone-ash), charred (bone-black), or converted into superphosphate.

We shall now see how these different methods of treatment affect their composition and action.

Bone-meal.

When simply broken or crushed their chemical composition is, of course, unaltered, and the principal advantage derived from their finer mechanical condition is the greater rapidity of their action. Whole bones resist decomposition within the soil for a considerable length of time, and it is very doubtful if their use is in any sense economical; in fact, as the object of artificial manuring is to feed the crop rather than the soil, it is doubtful whether slow-acting manures are in any case economical. The case of lime, which we have just considered, stands on a different footing. Lime is seldom applied as a direct plant-food. Its action is practically confined to the soil. The substances we have now to consider are valuable only when they are available as plant-food. They produce little or no permanent benefit to the soil, and if their decomposition is slow the plant receives its nourishment in small driblets, inadequate to its needs.

Bones are, therefore, most efficacious when crushed, and, within certain limits, the finer the powder the better the product as a manure. An additional advantage of fineness of division lies in the ease and evenness with which it can be distributed on the land, or mixed with other manures.

Bone-meal is decomposed in the earth, the nitrogen in the ossein being converted by putrefaction into ammonia, and the phosphate of lime rendered soluble by the action of carbonic acid and the vegetable acids. It is particularly suited to turnips and root-crops generally, grass, tobacco, fruit-trees, and in fact is a manure of almost universal application. It is applied at the rate of from 3 to 5 cwt. per acre, and if mixed with a manure containing potash, forms a complete manure, and an excellent substitute for stable manure. It is more particularly adapted to light soils, and is sometimes disappointing on heavy clays, the probable reason for which is that in stiff clay soils it is more or less protected from putrefaction (which we have seen is the cause of its efficacy) by the absence of air and moisture.

Boiled or steamed bones or bone-meal.—When bones or bone-meal are boiled, and more effectually when they are subjected to steam, the ossein of the bone is gelatinized, and more or less removed, whilst the fat is also removed, the resulting compound being, therefore, poorer in nitrogen, but richer in phosphoric acid. The treatment renders them more friable, and they are easily reduced to fine powder. The removal of the fatty matter also renders them more easily decomposed in the soil, as fresh bones are more or less protected from external action by the presence of the fat. The proportion of phosphoric acid is, therefore, not only increased, but the rapidity of action of the product, and its consequent effectiveness as a manure, is increased, at the expense, of course, of the nitrogen, which may be reduced 1 or 2 per cent., as is shown in the table on the next page.

Bone-ash.—The residue left after the calcination of bones consists, as we have seen, mainly of phosphate of lime, and contains no nitrogen. It is not largely used as a manure, its principal application being in the manufacture of superphosphate. It is dissolved in the soil by carbonic acid, and conveyed thus directly to the plant.

Bone-black is the product of charring bones. The broken bones are subjected to strong heat in closed iron cylinders, whereby they are converted into bone-charcoal, on exactly the same principle that wood is converted into wood-charcoal. The volatile matter of the bones is driven off in the form of gas, water, oil, and tar, and the carbon present is for the most part left mixed as charcoal with the mineral matter of the bones. This product is largely used by sugar-refiners for removing the colouring matter from raw syrups. After it has been used for this purpose a certain number of times it becomes unserviceable, and can be obtained at a cheap rate for manurial purposes. It may be applied directly to the soil as a phosphatic manure, or better converted into superphosphate by treatment with acid.

This substance is the basis of the manures manufactured by the Colonial Sugar Company.

Bone-black by itself is a purely phosphatic manure, containing only a very small proportion of nitrogen. The charcoal present has no fertilising value, and it is slightly poorer in phosphate of lime than bone-ash. It is, however, worthy of consideration as a manure on account of the low price at which it can be obtained.

The following table shows the alteration in composition which bones undergo when subjected to the above methods of treatment. The analyses are for the most part taken from Griffiths' work on manures, and are not analyses of the same sample, but represent fairly the average composition of the several products. The analyses of bone-black were kindly supplied by Mr. Walton, of the Sugar Company, and represent their "char" before and after it had been used for the purposes of refining.

	Bone-meal.	Boiled bones.	Steamed bone-meal.	Fermented bones.	Bone-ash.	Fresh bone-charcoal.	Spent charcoal.
Water	10·43	10·61	11·57	12·02	1·86	.....	2·0
*Organic matter, including 10% carbon in the case of charcoal ...	32·30	21·55	19·01	28·71	......	13·5	18·0
Calcium phosphate ...	48·40	60·19	60·02	49·28	86·34	76·0	74·0
Calcium carbonate alkalies, &c.	7·20	5·81	8·54	8·92	11·29	7·0	5·5
Insoluble	1·67	1·84	0·86	1·07	0·51	1·0	1·5
	100·	100·	100·	100·	100·	......	......
*Containing nitrogen ..	3·71	1·76	1·60	3·47	......	0·7	0·7

Utilising Waste Bones on the Farm.

The following are amongst the best methods of utilising waste bones on the farm, and converting them into manure when it is not feasible to grind them:—

1. *Fermented bones.*—Bones may be decomposed and rendered more active by mixing them with about one-fourth of their weight of loam, and keeping the heap moist with stable-liquor or urine. The heap should be protected from rain. By this process also there is a loss of nitrogen, but the phosphate is rendered more readily available and proportionately increased. This is a method that deserves to be made use of where bones are plentiful, and there is no means of reducing them to powder. Thirty to forty bushels per acre is the proportion recommended for grass lands.

2. Another method of fermenting bones, which I have taken from Mr. J. L. Thompson's notes in the *Agricultural Gazette*, is the following:—Bones may be softened by mixing in heaps with quicklime and loam. A layer 6 inches deep of bones, then a layer 3 inches deep of lime, and then a layer about 4 inches deep of loam, and so on, repeating until the heap is made of convenient height, when it is to be covered up with a thick layer of earth. Holes are then to be bored into the heap from the top and water poured in to slake the lime. The mass will become hot and remain so for two or three months, after which the bones will be found very friable, and the whole heap may be mixed together, and is ready for applying to the ground.

3. By conversion into superphosphate (*see* page 51).

Other Sources of Phosphoric Acid.

Mineral phosphates, or coprolites, are little used in the raw state as a manure; but as they form the basis of the bulk of the superphosphates and mixed manures on the market, a short account of them will not be out of place here.

The mineral known as apatite is a crystalline, phosphorite a non-crystalline, form of phosphate of lime. These occur as rock-masses, or in nodules embedded in rocks of sedimentary origin in many parts of the world, notably Canada, South Carolina, Florida, England, Spain, and Norway. The Canadian phosphate is a crystalline rock, the English coprolites are for the most part spherical nodules found in the green-sand and chalk.

Ground phosphate is the name usually given to the above compound when finely ground. They are not much used in this condition, but if so employed it is essential that they should be as finely ground as possible. They are non-nitrogenous.

Guano, in its original signification is the name applied to the dried dung of fish-eating sea-birds, and is obtained principally from the rocky islands in the Pacific and Atlantic Oceans. Guanos are either nitrogenous or contain no nitrogen, the amount of this ingredient decreasing with the age of the deposit. Guano was at one time very extensively used as a manure, but it is being largely superseded by cheaper and more concentrated forms of phosphoric acid and nitrogen. Nevertheless, it should not be overlooked, in view of the quantity of it existing in the islands of the Pacific Ocean off our own coasts.

The term is used locally to include a much more extensive class of substances. The dung of bats, flying-foxes, and marsupials goes under this name. A large number of artificial fertilisers are also sold as guanos.

The nitrogen exists often in the three forms of organic nitrogen, ammonium salts, and nitrates, the last form being the most soluble form in which nitrogen can be applied to the soil. They are excellent manures for cereals, especially as a top-dressing in the spring.

They likewise contain an appreciable percentage, 2 to 3 per cent., of potash.

The bulk, however, of the mineral phosphates and of phosphatic guanos are converted by treatment with sulphuric acid into superphosphates.

Superphosphates.—When bones, bone-ash, or any of the substances mentioned in the previous paragraphs, are acted upon by oil of vitriol, or sulphuric acid, the phosphate of lime which they contain, and which exists in the form of tri-calcium phosphate, is converted into a different lime compound, known as mono-calcium phosphate, or superphosphate. This substance differs chiefly from the original phosphate in being readily soluble in water. We have already seen that the availability of a manure as plant-food depends largely upon its ready solubility, consequently a phosphate of lime soluble in water is the most available form of this substance. Plants, however, are not dependent for their food-supply upon such compounds as are soluble in water, but are able, by means of the acid juices secreted in the roots and root-hairs, to avail themselves of a class of compounds soluble in vegetable acids. It is, indeed, very improbable that superphosphate remains in the soil for any length of time in that condition, for it is readily decomposed, both by carbonate of lime and by the iron and alumina salts present in the soil. Carbonate of lime converts it into a third compound of lime and phosphoric acid, known as bi-calcium phosphate. This substance is insoluble in water, but being in a very finely divided state is readily dissolved by the plant-acids. Iron and alumina attack the superphosphate even more rapidly, converting it into phosphates of iron and alumina, to which the same remarks apply.

This point is of further importance in reference to the composition of the superphosphates sold as manures, for they also usually contain a considerable quantity of the bi-phosphate in question.

A glance at the table of commercial fertilisers, on page 61 will make this clear. The action of the vegetable acids above mentioned may be fairly typified by that of citric acid or ammonium citrate, and the phosphoric acid represented in the tables as "citrate soluble" is just this bi-calcium phosphate, which is formed to a greater or less extent in such manures by the inter-action of superphosphate and unchanged tri-calcium phosphate. In a superphosphate, therefore, as usually purchased, there will be not only the water-soluble superphosphate, but also a certain quantity of the reverted phosphate, which is insoluble in water, but is, nevertheless, available for plant-food, and is of only slightly lower fertilising value than the water-soluble phosphate.

Superphosphate is essentially the manure for root-crops, and in all cases where a rapid return is wanted. For autumn manuring and for the manuring of permanent pasture, bone-dust is equally effective; and the conditions under which it will be advisable to use the one or the other form of phosphate will vary under different circumstances.

Superphosphates are more especially beneficial on soils of medium nature, and such as contain lime. Indeed, in sandy soils poor in lime it has been found to be of very little benefit. It must not be forgotten that it is an acid manure, and, in the absence of lime to neutralise it, may even prove injurious.

It is applied usually at the rate of 3 to 4 cwt. per acre, the amount varying with the nature of the soil and with the quantities of the other manures used in conjunction with it. It is of especial value in the case of turnips and root-crops, and it forms the basis of the "general" manures, special manures, mixed fertilisers, &c., such manures being usually prepared from superphosphates by mixing them with sulphate of ammonia or nitrate of soda and potash salts.

Superphosphate obtained from mineral phosphate contains no nitrogen; that obtained from bones usually contains 2 or 3 per cent., a portion of the nitrogen having been lost in the process.

The following table will serve to convey an idea of the result of the action of sulphuric acid upon mineral phosphates and upon bone-meal respectively:—

	Superphosphate from Mineral Phosphate.	Superphosphate from Bone-meal.
Water	16·00	10·00
*Volatile and combustible matter	9·50	33·00
Phosphate of lime (soluble in water)	28·00	31·50
Insoluble phosphate of lime...	6·00	2·00
Sand and insoluble matter	5·00	3·00
*Containing nitrogen	......	3·00
Equal to ammonia	......	3·60

The tendency to revert is greater in those superphosphates which contain iron and alumina, and in such manures a portion of the soluble phosphoric acid often reverts to the citrate-soluble condition on keeping for a length of time.

"*Dissolved bones*" is the name applied to superphosphate prepared from bones.

"*Dissolved guano*" is superphosphate obtained from guano.

"*Fish guano*" is not a guano, but fish offal.

"*Dissolved bone compound*" is a term applied to a mixed manure, prepared usually from mineral superphosphates, with the addition of bones, blood, &c.

Thomas phosphate, or *Basic slag*, must also be mentioned amongst phosphatic fertilisers. It is a waste product in the manufacture of steel by the Thomas-Gilchrist, or Basic process, and contains in the form of a phosphate of lime the phosphorus existing in the original impure pig-iron. In Germany enormous quantities of it are consumed, and in England its use is largely increasing. In these countries it can be obtained at very small cost, and has proved itself a very valuable and cheap form of phosphoric acid, its price in England being less than £2 per ton, but its great weight and the consequent cost of transport has, no doubt, hitherto prevented its economical use in this country.

"*Patent phosphate meal*" is the name given to a basic slag which is produced by a slight modification in the Thomas-Gilchrist process, and is very rich in phosphoric acid.

Manufacture of Superphosphate on the Small Scale.

The following directions for making this invaluable fertiliser on a small scale may prove useful on farms where bones accumulate, and the question arises how to deal with them most economically.

It will be found most satisfactory in the first instance to burn the bones and convert them into what is known as bone-ash, as fresh bones or bone-meal produce on treatment with acid a slimy mass which is exceedingly difficult to dry.

To prepare the superphosphate from bone-ash it is necessary to provide a receptacle for mixing the ingredients which is not attacked by sulphuric acid. A wooden trough lined with lead (a sheet of lead hammered to fit the trough) is about the best; but the wooden trough, pitched inside, will answer the purpose, or a hole in the ground lined with cement. In this receptacle the ingredients are mixed in the following proportions:—For every 40 lb. of bone-ash add 1 gallon of water and 15 lb. strong sulphuric acid (commercial oil of vitriol). Pour the whole of the water into the empty tank, then add *gradually*, stirring constantly with a wooden pole, the sulphuric acid. The acid combines very violently with the water, and unless it be added as directed above an explosion may result. Now add gradually, a little at a time, the bone-ash, stirring constantly with a stout pole or hoe. The above proportions should yield a mass possessing the consistence of a stiff dough. If it is not stiff enough some more bone-ash may be added. Leave it to itself for a few hours, when it will dry to a friable mass, easily broken, and in a fine state of division. Protect from rain whilst drying. The manure is now ready for use. Although burning the bones destroys the organic matter and diminishes the proportion of nitrogen, this loss is more than compensated for by the ease with which the product can be dried and handled. If fresh bones or bone-meal be used the fat which they contain prevents the complete action of the acid, and the resulting product is so slimy as to be unmanageable in many cases.

If it is preferred to use fresh bones or meal, the following proportions are said to be the best:—

Dilute every ½ gallon of acid with 1 gallon of water, as directed above—that is, add the acid to the water, stirring all the time. Never on any account add water to the strong acid. Pour this diluted acid upon 20 lb. of the bone-meal in the trough, taking care to pour slowly, stirring all the while. The sticky mass must now be mixed with loam, wood-ashes, peat, or gypsum, in order to dry it.

Instead of burning the bones the oil may be removed by steaming them, but this is rather a troublesome process, though a larger proportion of nitrogen is obtained by this means. Simple boiling with water is better than nothing, but in no case is the product so satisfactory as that prepared from burnt bones.

Instead of using acid, bones may be rendered soluble by allowing them to ferment. The following is a good plan:—

Dig a trench and fill it with alternate layers of wood-ashes and bones, beginning and ending with wood-ashes. Moisten each layer of ashes when laid, and keep the whole moist by watering from time to time. In a few months the heap may be turned over.

Bones are also dissolved by placing them in a pit and drenching with a hot solution of lye, 1 lb. of potash lye to every 4 lb. of bones. Cover with earth, and stir occasionally for two or three weeks, when the mixture may be turned out to dry.

It will be seen that treatment with acid is the most rapid, and the product just as satisfactory, but a little caution is required in mixing the ingredients

Manures containing Nitrogen.

Nitrogenous manures fall under three heads, according as the nitrogen they contain is combined with organic matter or exists in the form of ammonium compounds, or of nitrates. In the two latter forms it is soluble in water, and immediately available as plant-food. Most of the quick-acting concentrated fertilisers contain one or other of these compounds, usually sulphate of ammonia or nitrate of soda, and sometimes nitrate of potash. What is known as organic nitrogen is contained in animal products, refuse, and excreta, such as blood, bones, hair, meat, guano, farmyard manure, &c.

The nitrogen in these products is not in a state in which it can be immediately utilised by the plant, but requires first to undergo a fermentation within the soil, resulting in the first instance in the formation of ammonium compounds before it is available as plant-food. Now, although the nitrogen in these different substances is usually classified for the sake of convenience under the one heading of "organic" nitrogen, it occurs therein in a variety of combinations, some of which are more susceptible to fermentation than others, and consequently more rapid in their action. The smell of ammonia is soon noticeable from such products as urine and farmyard manure, which contain a large proportion of their nitrogen in the form of urea, whereas hair, wool, &c., resist decomposition for a considerable length of time.

The following list shows the order of solubility of the most commonly occurring of these products, the most soluble standing at the head:—

Fresh urine.
Dried blood.
Dried and pounded flesh.
Guano.
Fine bone-meal.
Oil-cake.
Fish scrap.
Dried offal.
Coarse bone-meal.
Horn-meal.
Dung.
Hair and wool.

This list is of course only intended to show the relative solubility of the nitrogen in the different substances named. It is not meant to apply rigidly in all cases, nor is it possible to draw such rigid comparisons, for the solubility will vary according to the fineness of division of the material, to some extent also with the nature of the soil and with the substances with which the manures in question are mixed, for they are seldom applied in a pure state, but are generally mixed with lime, or gypsum, or ashes, and the nature of this substance will affect their rate of fermentation. The list will serve its purpose if it makes clear the fact that some of these nitrogenous products are more soluble than others, just as some forms of phosphoric acid are more soluble than others, and that the percentage of nitrogen alone is not always a sufficient indication of the value of such manure, unless the source of the nitrogen is also known.

Those products containing their nitrogen in the most inert form, such as hides, horn, hair, &c., are generally utilised by the manure-makers by treatment with sulphuric acid in the manufacture of superphosphates. Their rapidity of decomposition is greatly increased by this means, or by mixing with lime, under which treatment they swell up, become soft, and decompose far more readily. They may also be usefully added to the compost heap.

The most important and most commonly used of these products are :—

Dried blood and dried flesh.—These substances are produced in considerable quantity in slaughter-houses and boiling-down works, and are dried by means of steam. They are almost identical in chemical composition, and contain on the average 11 to 13 per cent. nitrogen. They are specially beneficial on grass lands (about 30 bushels per acre), for cereals, turnips, and in fact all crops that require nitrogenous manures. They are less soluble than such manures as sulphate of ammonia and nitrate of soda, and are more applicable as an autumn manuring than as a top-dressing. With superphosphate and kainit they form a complete manure suitable for fruit trees, vines, potatoes, tobacco, and such crops.

Sulphate of ammonia is a manure of very great value, and being a waste product in the purification of coal-gas, it can be produced more cheaply than other soluble forms of nitrogen. It is obtained by treating the ammoniacal liquor of the gas-works with lime, which drives off the ammonia. The ammonia is absorbed by sulphuric acid and forms sulphate of ammonia. The ammoniacal liquor is a mixture of different ammonium compounds produced in the purification of coal-gas. Sulphate of ammonia is a white crystalline powder when pure. It is the most concentrated form of nitrogen we possess, containing about 20 per cent. of this element in combination. It is readily soluble and immediately available, and specially valuable as a top-dressing to the young crop.

For gardening purposes it may be dissolved in water (about ½ oz. to 1 oz. to the gallon), and will be found effective for most pot-plants and flowers. It is more particularly adapted for clay soils. It is stated to be ineffective on strongly calcareous soils, that is, soils which contain over 8 or 9 per cent. of carbonate of lime; but as the cultivated soils of the Colony appear to average something under 1 per cent., there is not much to be feared on this score. Sulphate of ammonia, or manures containing sulphate of ammonia, should not be mixed with lime, nor applied to land which has been recently limed. A still more effective form of available nitrogen exists in

Nitrate of soda, the principal source of which is the nitre-beds of Chili and Peru. Enormous quantities are exported to England and the European continent, and it is largely used in imported fertilisers, but its high price as compared with sulphate of ammonia renders its use here prohibitive.

Of other forms of nitrogen may be mentioned

Soot, which contains from 1 to 2 per cent. of nitrogen, principally in the form of ammonium compounds. It is fairly quick in its action, and at the rate of about 30 bushels per acre will be found useful for grass and vegetables.

GREEN-MANURING.

WE have seen in the case of many leguminous crops that they are not only independent of the soil for their supply of nitrogen, but that their growth actually enriches the soil in this ingredient. The land on which such a crop has been grown contains a larger proportion of nitrogen than before. This property is turned into account in rotating crops. When clover is grown between two crops of wheat, the second wheat crop derives the benefit of the nitrogen accumulated by the clover. It also suggests a means of supplying nitrogen to the soil without the addition of nitrogenous manures. If a leguminous crop is grown, and is ploughed into the land just before it reaches maturity, a manure is thereby added to the land containing about 100 lb. of nitrogen to the acre, that is to say, the land has received a manuring of nitrogen equivalent to that produced by the addition of 4 cwt. sulphate of ammonia or of 8 cwt. of dried blood per acre. Of course, with such treatment, the land is occupied for a certain length of time (dependent upon the rapidity of growth of the crop), and the crop so grown may be utilised to better advantage.

The crops suitable for green-manuring are, therefore, those that mature most rapidly, and occupy the ground for the shortest time, and which are otherwise of no great value. Perhaps such crops as the cow-pea, or vetches, or clover generally meet these requirements, but the choice will depend upon the surroundings of the individual. The crop may be fed as pasture to cattle, in which case a small proportion of fertilising matter is lost, which is nearly compensated for by the use of the crop as fodder.

Another advantage of green-manuring lies in the fact that by the decay of the crop thus ploughed in a supply of humus is produced, and the vegetable acids and carbonic acid produced by the decay of the plant assist in the decomposition of the soil and the liberation of available plant-food. They also bring up considerable quantities of plant-food from the sub-soil. Clay soils are specially benefited mechanically from the ploughing in of such crops.

INOCULATION OF THE SOIL FOR LEGUMINOUS CROPS.

"Nitragin."

"NITRAGIN" is the registered trade name for the pure cultures of the bacteria contained in the root-nodules of several of the leguminous crops.

These preparations are now on the European market, and it is contended for them that their use will increase the power possessed by certain leguminous crops of assimilating atmospheric nitrogen, thus doing away with the necessity for nitrogenous manuring, and assuring a good yield even in soils poor in nitrogen, and further increasing the amount of assimilable nitrogen in the soil.

As has been already explained, Messrs. Hellriegel and Wilfarth were the first to demonstrate the fact that certain leguminous plants have the power of fixing atmospheric nitrogen by means of nodules or excrescences upon their roots.

These excrescences were found to contain bacteria, which are the active agents in the assimilation of free nitrogen.

Amongst cultivated crops, those which possess this property are leguminous plants of the order *Papilionaceæ*, comprising a large number of important fodder-crops, such as lucerne and the clovers, peas, vetches, lupins, &c.

Before Hellriegel's classical investigations it was known that these crops were not only independent of soil-nitrogen and nitrogenous manuring for their growth, but that they actually enriched the soil in this ingredient.

The success which attended the practice of growing a crop of this nature immediately before sowing the land with wheat is due, as we now know, to the fact that the wheat-crop is benefited by the increase in the assimilable nitrogen of the soil produced by the growth of the leguminous crop.

It was also known that the soil itself on which such a leguminous crop had grown was especially suitable for a similar crop—that is to say, if earth taken from a field which had supported a good crop of clover was added to land which was less suitable to the growth of clover, it increased the fertility of this land as far as clover was concerned. Even watery extracts of such soil were found to have the same effect.

It is to Professor Hellriegel that we owe the explanation of these phenomena, and since his discovery numerous experiments have been conducted with a view of utilising this knowledge for practical purposes.

The name of Professor Nobbe, of Tharand, Saxony, has been chiefly associated with this work, and he has brought his experiments to what appears likely to be a successful issue.

Professor Nobbe prepares pure cultures of the bacteria contained in the root-nodules of different plants by a method familiar to bacteriologists.

Plates of specially-prepared gelatine are, in the first instance, inoculated with the contents of the nodules of any particular plant of which it is desired to obtain the characteristic bacterium. One of the colonies thus propagated is used to inoculate a second plate, and this process is repeated until a pure culture is obtained of the organism supposed to be peculiar to the plant in question.

The bacteria thus obtained from the nodules of different plants are themselves so nearly alike as to be practically indistinguishable from one another. Nevertheless, they appear to have undergone some remarkable alteration, which renders their action distinct in each case.

Hence, although the organism extracted from the root-nodules of, say, a pea is favourable to nodule formation when introduced into a soil on which other peas are growing, it yields negative results when introduced into soil on which clover grows—that is to say, the organism promotes nodule formation and assimilation of nitrogen only upon plants of the same kind as that from which it has been taken. This is exactly what was observed in the case of soil used for inoculation.

The pure culture is then introduced into prepared gelatine, and is ready for the market.

The purchaser receives a small glass bottle, sealed and protected from the light, at the bottom of which is a small quantity of gelatine somewhat cloudy in appearance from the presence of colonies of bacteria.

Dr. Voelcker, in the Journal of the Royal Agricultural Society of England, describes the commercial article as follows:—

"Up to the present time there have been prepared and put on the market pure cultivations of the organisms derived from the nodules found on the roots, and suitable for application to the growth of the following seventeen leguminous field-crops:—

1, Pea (*Pisum sativum*); 2, Field pea (*Pisum arvense*); 3, Vetches or tares (*Vicia sativa*); 4, Field or horse-bean (*Vicia faba*, or *Faba vulgaris*); 5, White lupins (*Lupinus albus*); 6, Yellow lupins (*Lupinus lutens*); 7, Blue lupins (*Lupinus angustifolius*); 8, Red clover (*Trifolium pratense*); 9, White clover (*Trifolium repens*); 10, Alsike (*Trifolium hybridum*); 11, Trifolium or crimson clover (*Trifolium incarnatum*); 12, Cow-grass (*Trifolium pratense perenne*); 13, Trefoil, yellow or "hop" clover (*Medicago lupulina*); 14, Lucerne (*Medicago sativa*); 15, Sainfoin (*Onobrychis sativa*); 16, Serradella (*Ornithopus sativus*); 17, *Lathyris sylvestris*.

Others will be shortly added to the list, *e.g.*, Kidney-vetch (*Anthyllis vulneraria*); Bokhara clover (*Melilotus alba*).

"Each bottle as sold bears a differently-coloured label, according to the kind of crop it is intended for, and also the German and the botanical name of the plant. The contents of a single bottle are sufficient for securing the inoculation of about half an acre of the land on which the crop is to be sown, and the present cost of a single bottle is M. 2·50, or about 2s. 6d. in English money. Thus the additional cost of inoculating a crop would come to about 5s. an acre. To look at, a bottle appears to contain at the bottom of it about an inch and a half depth of a light brown jelly, ramifying throughout which may be noticed a white growth or mould. The two principal precautions that must be taken with the material are (1) not to let it experience a heat greater than the body temperature (about 98 degrees Fah.); and (2) not to let it be exposed to a strong light. Either of these would destroy the vitality of the bacteria, but if they be guarded against, the efficacy of the contents may be prolonged for an indefinite time.

"The method of using the 'Nitragin' in practical agriculture is twofold. It consists either in inoculating the seed direct, by bringing it by means of water, into contact with the 'Nitragin,' or in inoculating with the 'Nitragin' some of the soil of the field on which the crop is to be sown, and then spreading this soil over the plot and working it in to a depth of about 3 inches. The first thing to be done is to render the contents of the bottle liquid; this is effected either by putting the bottle for a short time into lukewarm water, or by bringing it into a warm room until the contents become liquid, or by other obvious means. Care must be taken, as already pointed out, not to exceed a temperature of 98 degrees Fah., and not to expose the bottle to strong light. The following is, practically, a translation of the directions for use.

I. *For inoculating the Seed direct.*

"For every half acre of land to be sown with the crop, take 1⅓ pints of water in a vessel, and pour into it the liquid contents of one bottle. In order to completely empty the bottle, shake up some of the water with the liquid contents of the bottle, so that the whole gets well mixed, and then pour it into the vessel containing the water.

"With the water thus prepared, sprinkle the seed thoroughly, and work the heap with the hand (in the case of larger quantities with a shovel), so that every seed is moistened. If there be not sufficient water, add more, but, speaking generally, 1⅓ pints is enough for small clover-like seeds. Dry the seed by mixing it with some dry sand or fine earth taken from the field that is to be sown. Avoid excessive dryness or dustiness, and do not expose to bright sunlight. Sow in the usual way.

II. *For inoculating the Soil.*

"Instead of inoculating the seed direct, it is rather better to effect this purpose by inoculation of the earth of the field that is to be sown. To do this, for each half acre of land that is to be sown, take 56 lb. of earth from the field, and pour the contents of the bottle over it as directed before, but using very much more water. In this way the earth will be inoculated. Let the earth dry in the air, or, if necessary, add more dry earth.

"Then spread the whole evenly over the surface to be sown with seed, and work it into the soil to a depth of about 3 inches. Sow the seed as usual."

As a practical application, "Nitragin" is still only in its experimental stage, and it has not yet been tried under the ordinary conditions of agriculture often enough to speak definitely as to the success attending its application.

The beneficial action of the substance depends entirely upon the phenomena above described, that is to say, the presence of the bacteria promotes the growth of root-nodules, and thereby increases the power of the plant to assimilate nitrogen. It acts thus as a purely nitrogenous manure, and its action is practically on all fours with that produced by the ploughing-in of a green leguminous crop, and has the great advantage of producing this effect in a rapid, economical, and handy form.

If its success at all approaches what one may reasonably expect, it will prove to be one of the most valuable contributions ever made by science to practical agriculture. It is of especial interest to us in Australia, because so many of our principal fodder-crops belong to the class of plants under discussion. Whether our conditions, especially as to temperature and moisture, are favourable or otherwise to the treatment, is a problem we shall have to solve for ourselves.

The real value of the preparation appears likely to be in the inoculation of soils which, owing to the absence of the proper organism, are incapable of supporting one or other of the above-mentioned crops.

On land which yields good crops of (say) clover, the introduction of the clover organism is not likely to be of any great benefit.

The question as to whether what is known as "clover-sickness" is in reality attributable to the absence of the proper bacterium in the soil, and whether the introduction of this organism will effect a cure in such cases, is a question whose solution is of the greatest importance.

Those who wish to study the latest work done in this interesting subject cannot do better than read the articles by Dr. Miller, of Rothamstead, and Dr. Voelcker, which appear in No. 26 of the Journal of the Royal Agricultural Society of England.

Manures containing Potash.

With the exception of wood ashes, we are dependent upon the German potash deposits for our supplies of this invaluable manure. Potash occurs in these deposits in combination with other substances in different minerals of which the commonest is *kainit*.

Kainit is a mixture of the sulphates of potash and lime, together with chlorides of magnesium and sodium. It is of value principally on account of its potash, of which there is about 12 per cent. For leguminous crops, root-crops, fruit, vines, &c., it is an essential manure. It should always be mixed with other manures, especially phosphatic manures, about 2 cwt. mixed with 3 cwt. superphosphate, and 1 or 1½ cwt. sulphate of ammonia per acre being about the best proportion for potatoes. Kainit is the cheapest of the potash manures for the farmers' use, but the value of wood-ashes must not be overlooked by those who are able to obtain it in quantity. If wood-ashes be substituted for kainit in any of the formulæ given above, about 4 to 5 times the quantity of wood-ashes must be used, thus half a ton of wood-ashes is about equivalent to 2 cwt. kainit.

Sulphate of Potash is also obtained from the same source as the above and is a very concentrated form of potash, of which it contains about 50 per cent. As it contains no chlorine it is preferable to kainit for such crops as tobacco. It is more economical on account of its concentrated nature, 1 cwt. of it containing as much potash as 4 cwt. of kainit. At the same time, this and other highly-concentrated manures should be used with caution until experience is gained in the use of the less concentrated forms.

Wood-ashes.

The value of wood-ashes as a fertilising material is not as widely known as it deserves to be. In newly-cleared country this valuable substance is produced in large quantities, and it will be found to more than repay the trouble of returning to the land. It is a matter of common observation that after a bush-fire the vegetation is particularly strong and luxuriant, and the effect is due entirely to the lime, potash, and phosphoric acid thus returned to the soil. The household fires also furnish a small but continual supply of ashes which should all be kept and made use of. They may be utilised, either by themselves, or mixed with other manures, or added to the compost-heap, a valuable adjunct to the economy of the farm.

The ash of the different woods contains the mineral portion of the wood from which it has been obtained. Of these ingredients the bodies possessing fertilising value are lime, potash, and phosphoric acid. Their potash and phosphoric acid are, moreover, in an exceedingly soluble condition, and are in such a state as to be readily assimilated by most plants. The value of the ash of the different varieties of European trees has been long well known and their constitution established by numerous exact analyses. The composition of the ash of our own trees has not as yet been studied, but from the following analyses made in the Department, it will be seen that they are likely to be quite as valuable. The results of the examination of a larger number will be published shortly in a future number of the *Gazette.*

	Phosphoric Acid.	Potash.
Spotted gum	·10	·69
Red gum	·38	4·17
Bloodwood	·80	1·50
Box	·68	1·68
Blackbutt	·04	2·02
Ironbark	·82	1·53
Red apple	·57	5·11
Box	·92	1·02
Grape-vine	1·85	3·76

The process of burning converts the potash salts into carbonate of potash for the most part, the lime is present in the form of oxide and carbonate, and the phosphoric acid partly as calcium phosphate, and partly as alkaline phosphates. Now, carbonate of potash and alkaline phosphates are particularly soluble forms of potash and phosphoric acid respectively, the beneficial action of lime, both in the form of oxide (quicklime) and of carbonate (chalk), is well known. It will, therefore, readily be seen what a valuable manurial substance we have got here. In addition to their direct action as plant-food, wood-ashes act beneficially in improving the quality of stiff clay-lands, and equally so in binding light sandy soils. In fact, they benefit the soil mechanically exactly in the same way that lime does. With the exception of nitrogen which, cf course, has been burnt off, they contain all the ingredients of a complete manure, and in a particularly serviceable form. It might, therefore, be expected that the addition of a nitrogenous manure would make a complete manure of them. But such addition must be made with great caution, as the presence of free lime and alkalies in the wood-ashes are liable to decompose the nitrogen in such a mixture, driving it off in the form of ammonia, the smell of which will be apparent when sulphate of ammonium and wood-ashes are mixed together.

The ash of young wood is especially rich in potash, and, generally speaking, the ash of young and small wood, as young boughs, twigs, &c., is more valuable than that obtained from the trunk or heart of an old tree.

The following are the best means of utilising wood-ashes:—

They may be used alone as a top-dressing to grass and pasture, and for leguminous plants; but they are of benefit to nearly all crops, potatoes and roots, fruit and vines being specially benefited. They are applied at the rate of from 35 to 30 bushels per acre.

A mixture of wood-ashes and bone-meal in the proportion of 5 cwt. bone-meal to 25 bushels ashes is said to be an excellent substitute for farm-yard manure. Such a mixture should be made as required—not kept mixed.

Instead of mixing superphosphate with loam or earth when applying it to the land, it may be advantageously mixed with three or four times its weight of wood-ashes. But the best way of utilising wood-ashes is

The Compost Heap.

The best material with which to compost it is undoubtedly peat, but other decayed or decaying vegetable matter is nearly as good, such as straw, dead leaves, and refuse of this sort generally. Such substances are fermented in contact with wood-ashes, and their nitrogen rendered available. The most convenient form of the compost-heap will vary on different farms, and the subject is so wide and important that it requires a chapter to itself. On farms where the compost-heap is an institution, it should not be forgotten that the addition of wood-ashes forms the best method of utilising this product and improves the value of the compost-heap. Where such a system of utilisation of waste matter is not practised, the following method of composting ashes will be found useful:—Make a heap of alternate layers of peat or peaty loam, or vegetable refuse, and wood-ashes, or make a hole and fill it with these substances in alternate layers, moisten the heap with urine or slop-water, and allow to ferment for a few months, when it may be turned over. The addition of stable-manure, dung, and in fact all refuse-matter of the farm will benefit such a heap, which may be thus made the means of utilising a great deal of valuable fertilising material which would otherwise be thrown away.

The above remarks apply to unleached ashes, such as are obtained from the burning of timber.

Leached ashes contain practically little but lime and carbonate of lime, as the potash and phosphoric acid are for the most part leached out. Their use and action are similar to those described under the heading of carbonate of lime. They may be sometimes economically used instead of this substance, but in no case will the farmer derive any benefit from leaching his own ashes. As the above analyses will show, it is chiefly for the sake of their potash that wood-ashes are used, and they may be regarded as potash manures. They are not nearly so concentrated a form of this substance as potash salts, and if substituted for kainit in any of the formulæ recommended in the preceding pages, it is well to remember that 1 cwt. kainit contains about the same quantity of potash as 4 or 5 cwt. wood-ashes.

Sea-weed as a Manure.

Sea-weed is not at a first glance a very promising fertilising material. It has, when fresh, a fertilising value somewhat lower than that of farmyard manure, and its large content of water prevents its carriage in a fresh state to any distance with economy. Even at the distance of a few miles from the coast the cost and labour of transport places it out of court as a fertiliser. Its use is, therefore, limited to farms situated immediately upon an accessible coast; but in such cases there is no doubt that it might be applied with advantage more frequently than at present.

In the coastal districts of Great Britain (especially Scotland and Ireland), France, Norway, and the United States, sea-weed is largely used as manure. The general custom is to fork it straight into the land like dung, and this is the best method for such sea-weeds as decompose rapidly, and can be easily distributed, such as the different varieties of kelp and ribbon-weed. These may be strewn over the land or ploughed lightly in, and rapidly decompose and disappear. For the tougher kinds, such as eel-grass, it is usually recommended to compost with lime. This is done by building a stack of alternate layers of sea-weed and lime, the layers of sea-weed being about 6 inches deep, and covered with lime. The whole stack may be conveniently covered with gypsum to prevent loss of ammonia. The heap is left for two or three months, and then turned over at intervals until well rotted. It is doubtful whether composting is economical in the case of the more readily decomposed varieties above mentioned.

Though a poor manure, it is fairly rich in nitrogen and potash, its weak point being its phosphoric acid. For this reason a previous dressing of the soil with bone-dust is stated to be beneficial. Its use must be avoided on certain crops, such as beetroot and tobacco, which are injuriously affected by chlorides, which are present in sea-weed in considerable quantities in the form of common salt. For the same reason, plants such as asparagus, and small fruit, such as raspberries, which require much saline matter, are benefited by its use. Potatoes are said to contain less starch when manured with sea-weed, and to acquire in consequence a somewhat soapy taste; at the same time, in many parts of the coast of Ireland, sea-weed is almost the only manure used by the peasant for his potato crop.

It must be carefully spread, especially if used as a top-dressing for meadows, as it is otherwise liable to destroy the grass when used in large quantities.

Storer, in his work on Agriculture, points out that it is entirely free from seeds of weeds, spores of fungi, and eggs of insects, consequently it is a comparatively easy matter to keep the land clean.

The ash of sea-weed contains a considerable quantity of fertilising materials, potash, and phosphoric acid, and in some cases it may be found economical to utilise sea-weed in this form. The nitrogenous matter is, of course, thereby lost. The ash is richer in fertilising substances than wood ashes—the potash varies in the different varieties from 4 to as high as 20 per cent.

Except for the larger amount of water contained in it, sea-weed compares favourably with farmyard manure.

The average composition of cow-manure is roughly :—

Water...	77·0 per cent.
Nitrogen	·5 „
Potash	·6 „
Phosphoric acid	·15 „

The following table shows the composition of the most abundant species of sea-weeds, determined by Messrs. Wheeler and Hartwell, of the Rhode Island Experimental Station, who have also collected a large amount of valuable information as to the use of these plants:—

	Water.	Nitrogen.	Potash.	Phosphoric Acid.
Ribbon-weed, Kelp, Tangle, *Laminaria saccharina*	87·99	·17	·16	·05
Broad-ribbon weed, Broad-leafed Kelp, Devil's apron Tangle, *Laminaria digitata*	87·50	·23	·31	·06
Dulse, Dillisk, *Rhodymenia palmata*	86·25	·37	1·07	·09
Round-stalked rock-weed, *Ascophyllum* (*Fucus*) *nodosum*	77·26	·24	·64	·08
Flat-stalked rock-weed, *Fucus vesiculosus*... ...	76·55	·38	.65	·12
Irish or Carragheen Moss, *Chondrus crispus* ...	76·03	·57	1·02	·13
Eel-grass, grass wrack, *Zostera marina*	81·19	·35	·32	·07

ANALYSES OF COMMERCIAL FERTILISERS OBTAINABLE IN NEW SOUTH WALES.

1898 List.

F. B. GUTHRIE AND E. H. GURNEY.

THE accompanying list of manures obtainable in the Colony, together with their composition as determined by analysis, and their price, is the result of revision of the list issued in May, 1897.

The list is compiled in the interest of the farmers; and it is hoped that it may serve as a guide to those requiring any particular class of manure.

In every case the figures given are those obtained from samples submitted to the Department for analysis.

The fertilisers sold by the Colonial Sugar Company have, however, not been thus checked in all cases, Mr. Walton's figures being published.

Messrs. Geo. Shirley & Co. inform us that they have been appointed sole agents for the "Lawes Chemical Company," London, the high standard of whose fertilisers is well known. These fertilisers may be expected to arrive shortly. The same firm are also agents for a new potash-manure, manufactured locally, and which will also be shortly in the market.

A word is necessary in explanation of the column giving the "values" of the manures. These figures are calculated from the composition of the manures as represented by analysis, a definite unit-value being assigned to each of the fertilising ingredients. The units on which the values here given are computed are as follows :—

UNIT-VALUES of fertilising ingredients in different manures for 1898.

Nitrogen in ammonium salts and nitrates	9s. 6d. per unit.
Nitrogen in blood, bones, offal, &c.—fine	10s. „
Phosphoric acid in bones, offal, &c.—fine	2s. „
Phosphoric acid in superphosphate—	
„ water-soluble	5s. 4d. „
„ citrate-soluble	4s. 6d. „
„ insoluble	2s. „
Potash	5s. 4d. „

To determine the value of any manure the percentage of each ingredient is multiplied by the unit-value assigned above to that ingredient, the result being the value per ton of that substance in the manure. For example, a bone-dust contains 4 per cent. nitrogen and 20 per cent. phosphoric acid:—

4 × 10s. = £2 = value of the nitrogen per ton.
20 × 2s. = £2 = value of the phosphoric acid per ton.

£4 = value of manure per ton.

It must be clearly understood that the value thus assigned, depending solely upon the chemical composition of the manure, does not represent in all cases the actual money value of the manure, which depends upon a variety of causes other than the composition, and is affected by local conditions.

It is simply intended as a standard by which different products may be compared. At the same time, it has been attempted to make the standard indicate as nearly as possible the fair retail price of the manure, and the fact that in the majority of cases the price asked and the value assigned are fairly close shows that the valuation is a reasonable one.

To economise space, only those ingredients are given whose presence directly affects the value of the manures. Full analyses can be obtained if desired.

In the table of mixed fertilisers, &c., it will be noticed that three columns are assigned to phosphoric acid, and a different unit-value assigned to each, water-soluble, citrate-soluble, and insoluble. When bones or mineral phosphates are acted on by sulphuric acid, a portion of the tri-calcic phosphate is converted into another lime-compound, known as mono-calcic phosphate or superphosphate. This compound is soluble in water, and it is to its presence that the rapid action of the phosphate is due.

This is the "water-soluble" acid of the table.

In many superphosphates, however, a considerable portion of this compound has undergone change. This change may be due to the quantity of sulphuric acid used in the manufacture, to the quantity of salts of iron and alumina present, or to the length of time it has been kept, and it results in the formation of a third lime-compound—bi-calcic phosphate. This is known as "reverted" or "retrograde" phosphoric acid, and, being insoluble in water, but soluble in ammonium citrate, is here given under the heading "citrate-soluble." A value has been assigned to the phosphoric acid in this condition intermediate between the others. Its manurial activity has been found to be very little less than that of the water-soluble acid.

As many manure manufacturers prefer to use the term "reverted," it is well to keep in mind that in this list the term is identical with "citrate-soluble." The only exception is in the case of Thomas phosphate. In this product the "citrate-soluble" is a compound of lime distinct from the others; it is neither bone-phosphate nor superphosphate, nor reverted phosphate, but is a fourth lime-compound, known as tetra-calcic phosphate. It is soluble in ammonium citrate, and has practically the same manurial activity as reverted phosphate.

In the fifth table are a number of waste products which may in many cases be economically utilised.

I.—SIMPLE FERTILISERS.

Manure.	Where obtainable.	Nitrogen.	Equivalent to Ammonia.	Lime.	Potash. (K_2O)	Value.	Price asked.
						£ s. d.	£ s. d.
Sulphate of Ammonia	Australian Gaslight Co.	20·70	25·13	....	....	9 16 6	9 0 0
Kainit	Australian Manures Co., 39A., Market-street	....	....	....	12·95	3 9 0	4 0 0*
Sulphate of Potash	,, ,, ...	....	....	....	52·37	13 19 0	13 10 0
Muriate of Potash	,, ,, ...	....	....	....	59·00	15 0 0	13 15 0
Nitrate of Soda	,, ,, ...	15·25	....	....	....	7 5 0	15 12 0
Sulphate of Ammonia	,, ,, ...	20·70	25·13	....	....	9 16 6	9 0 0
Kainit	George Shirley & Co., Pitt-street	....	....	....	12·95	3 9 0	4 0 0*
Muriate of Potash	,, ,, ...	....	....	....	59·00	15 0 0	13 15 0
Sulphate of Potash	,, ,, ...	....	....	....	52·37	13 19 0	13 10 0
Nitrate of Potash	,, ,, ...	13·50	....	....	44·62	17 8 0	20 0 0
Sulphate of Ammonia	,, ,, ...	20·30	24·60	....	....	9 0 6	9 0 0
Nitrate of Soda	,, ,, ...	15·25	....	....	....	7 5 0	15 12 0
Lime	Cullen Bullen Lime Co., Sussex-street	....	....	93·00	....	......	1 13 0†
Agricultural Lime	,, ,, ...	....	....	70·00	....	......	0 16 0‡

* Kainit also contains 30 per cent. of magnesium salts. † 22s. 6d. per ton on rail at Portland. ‡ 8s. per ton on rail at Portland.

II.—BONE AND BLOOD MANURES.

Manure.		Where obtainable.	Moisture.	Insoluble Matter.	Nitrogen.	Equivalent to Ammonia.	Phosphoric Acid.	Equivalent to Tri-calcic Phosphate.	Value.	Price asked.
									£ s. d.	£ s. d.
Bone-dust		Sydney Soap and Candle Co., 337, Kent-street.	4·93	2·73	4·93	5·98	20·24	44·19	4 10 0	4 10 0
Refuse—Ashmagandy ..		Sydney Soap and Candle Co., 337, Kent-street.	6·06	1·99	7·05	8·61	15·40	33·63	5 1 0	....
Bone-dust ..	No. 3	Geo. Shirley and Co., Pitt-street	2·50	6·43	2·66	3·23	24·12	52·67	3 15 0	4 5 0
	No. 4	,, ,, ..	4·94	0·32	6·58	7·99	14·91	32·57	4 15 6	4 5 0
	No. 7	,, ,, ..	5·18	11·86	3·92	4·76	18·67	40·77	3 16 6	4 5 0
	No. 8	,, ,, ..	3·60	11·01	2·80	3·40	19·25	42·03	3 6 6	4 5 0
	No. 11	,, ,, ..	3·97	8·19	3·22	3·91	21·48	46·91	3 15 0	4 5 0
Blood manure		,, ,, ..	11·16	0·24	11·34	13·77	....	....	5 13 6	6 0 0
Bone-dust		Australian Manure Co., 39A, Market-st.	3·77	2·10	5·32	6·46	23·17	50·59	4 19 6	4 5 0
Pure bone-dust .. .		,, ,, ..	5·23	3·07	4·20	5·10	23·59	51·50	4 0	4 5 0
Bourke bone-dust		,, ,, ..	5·77	4·41	6·93	8·41	11·09	24·21	4 11 6	4 5 0

Blood and bone manure ..	„ „ ..	5·18	0·83	6·72	8·16	10·79	23·57	4 9 0	4 5 0
Dried blood	„ „ ..	9·53	2·03	12·39	15.04	....	....	6 4 0	6 0 0
"Nipho"	„ „ ..	8·58	0·62	12·11	14·70	1·05	2·29	6 1 0	6 0 0
"Nitrogenite"	„ „ ..	8·50	0·44	12·11	14·70	....	....	6 1 0	6 0 0
Gee's Fertiliser, B.B	Sydney Meat-preserving Co., Rookwood and Auburn.	6·69	0·62	7·84	8·52	9·70	21·19	4 18 0	5 5 0
"Nipho"	Sydney By-product Manufacturing Co., Alexandria. Agents :—Geo. Shirley and Co.	8·58	0·62	12·11	14·70	1·05	2·29	6 1 0	6 0 0
"Nitrogenite"	R. Fisher	8·50	0·44	12·11	14·70	....	....	6 1 0	6 0 0
Steamed bone-dust	Pyramid Bone Mills and Manure Works, Alexandria ; W. S. Laurie and Co.	5·00	2·94	3·78	4·59	23·23	50·73	4 4 0	4 7 6
Digested bone-dust	„ „ ..	5·35	4·92	3·36	4·08	20·64	45·06	3 15 0	4 5 0
Raw bone-dust	„ „ ..	5·35	2·22	4·06	4·93	22·81	49·80	4 6 0	4 5 0
Bone-dust	A. Wooster, Carlingford	4·97	3·12	3·84	4·66	22·44	49·00	4 3 0	3 15 0*
„	D. Davies, Bulli	6·55	1·02	4·06	4·93	24·92	54·41	4 19 0	4 5 0

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* Special prices for large quantities.

III.—SUPERPHOSPHATES, MIXED FERTILISERS, AND IMPORTED FERTILISERS.

Manure.	Where obtainable.	Water.	Nitrogen.	Equivalent to Ammonia.	Insoluble matter.	Water Soluble Phosphoric Acid.	Citrate Soluble Phosphoric Acid.	Insoluble Phosphoric Acid.	Potash.	Value.	Price asked.
										£ s. d.	£ s. d.
Odam s Superphosphate	Holdsworth and Macpherson, 254, George-street.	12·82	......	......	3·58	15·80	1·10	1·29	......	4 11 6	6 10 0
Odam's Complete Manure	" " ..	10·01	3·50	4·25	7·54	10·42	0·86	1·29	5·48	6 4 0	10 0 0
Ohlendorff's Dissolved Peruvian Guano.	Gibbs, Bright, & Co.	8·50	5·74	6·97	7·43	11·78	......	......	2·06	6 11 0	14 0 0
Albert's Thomas Phosphate.	Australian Manures Co., 39A, Market-street.	......	......	......	......	......	6·11	13·79	......	2 15 0	4 10 0
Guano	" " ..	......	0·70	0·85	......	......	......	1·75	......	2 10 0	3 12 0
Turnip Manure	Pyramid Bone Mills and Manure Works, Alexandria; W. S. Laurie & Co.	......	1·50	1·8	......	1·50	1·00	8·00	3·50	3 2 0	4 15 0
Potato Manure	" " ..	......	3·50	4·2	......	4 00	......	1·50	5·50	4 7 0	5 5 0
Compound Kainit ..	" " ..	......	......	......	......	......	......	......	10·90	2 18 0	4 0 0
Lawe's Superphosphate	" " ..	......	......	......	......	14·56	1·92	0·49	......	4 7 0	4 5 0

IV.—COLONIAL SUGAR COMPANY'S FERTILISERS.

Manure.		Where obtainable.	Nitrogen.	Equivalent to Ammonia.	Water Soluble Bone Phosphate.	Citrate Soluble Bone Phosphate.	Insoluble Bone Phosphate.	Equivalent to total Bone Phosphate.	Potash.	Value.	Price asked.
										£ s. d.	£ s. d.
Superphosphates or Soluble Series.	No. 1	Colonial Sugar Refining Co. Agents—Geo. Shirley & Co., Pitt-street.	....	....	37·	....	....	37·	....	4 11 0	4 5 0
	2	" " ..	1·6	2·	33·	....	....	33·	1·	5 1 0	5 2 6
	3	" " ..	3·3	4·	28·	....	....	28·	2·	5 11 0	6 2 6
	4	" " ..	4·9	6·	24·	....	....	24·	4·	6 8 6	7 2 6
	5	" " ..	3·3	4·	26·	....	....	26·	7·	6 12 6	7 2 6
	6	" " ..	0·8	1·	30·	....	....	30·	7·	6 0 0	6 2 6
Cheap Superphosphate Series.	No. 10	" " ..	....	....	15·	8·	24·	47·	....	3 14 0	3 12 6
	11	" " ..	1·6	2·	12·	7·	23·	42·	1·	4 5 6	4 7 6
	12	" " ..	3·3	4·	12·	5·	15·	32·	2·	4 15 0	5 2 6
	13	" " ..	1·6	2·	12·	6·	19·	37·	5·	5 1 0	5 7 6
	14	" " ..	2·5	3·	12·	5·	14·	31·	6·	5 7 6	5 17 6
Bone Phosphate Series "Reverted."	A	" " ..	....	....	....	18·	42·	60·	....	3 15 6	3 9 0
	B	" " ..	0·8	1·	....	17·	38·	55·	1·	4 3 0	3 10 0
	C	" " ..	0·8	1·	....	16·	36·	52·	3·	4 9 6	4 0 0
	D	" " ..	1·6	2·	....	14·	33·	47·	4·	4 16 0	4 10 0
	E	" " ..	2·5	3·	....	10·	31·	41·	6·	5 4 0	5 10 0

V.—WASTE-PRODUCTS, ASHES, &C.

Manure.		Where obtainable.	Water.	Volatile and Combustible.	Nitrogen.	Ammonia.	Insoluble.	Lime.	Phosphoric Acid.	Potash.	Value.
											£ s. d.
Deposit from wool-scouring tanks.	1	Liverpool Wool-scouring Works.	....	....	·64	·73	....	....	....	·72	0 10 3
	2	„ „ ..	....	....	1·02	1·24	....	....	·16	·39	0 12 0
	3	„ „ ..	....	....	1·37	1 06	....	....	·14	·20	0 14 0
Sheep-manure		„ „ ..	9·71	50·91	1·79	2·17	32·26	2· 0	·91	·92	1 3 9
"Skutch" from limed pelts ..		Hugh Wright, Auburn..	5·32	73·42	1·80	2·18	3·61	9·36	·89	·20	0 19 0
Decomposed hair and lime ..		Felmongery	9·70	57·03	6·86	8·33	1·22	26·27	....	....	3 3 6
Bat-deposit		Cave Flat, Cooradigbee..	5·43	12·98	·50	·61	57·64	5·60	12·12	....	0 19 7
Tan-yard refuse		Tanneries, St. Mary's ..	6·43	33·83	2 24	2·72	21·43	26·96	·67	....	1 1 6
Filter-press muck		Cane-mills, Broadwater	16·39	26·07	·22	·27	84·86	18·20	*5·98	·44	1 12 0
Megass		Clarence River cane ..	22·86	67·32	·63	·78	8·61	·30	·01	·06	0 6 0
Megass-ash		„ „ ..	....	....	....	....	87·69	3·07	·16	·51	0 3 3
„		Richmond „ ..	....	....	....	....	....	1·11	·28	4·79	1 9 0
Bloodwood-ash		....	....	....	....	....	....	8·47	·27	5·25	1 11 9
Ironbark		....	....	....	....	....	....	....	·82	1·53	0 10 0
Blackbutt-ash		....	....	....	....	....	....	7·27	·04	2·02	0 12 0
Red-gum-ash		....	....	....	....	....	....	....	·38	4·17	1 5 6
Spotted-gum-ash		....	....	....	....	....	....	....	·10	·70	0 4 3
Boxwood-ash..		....	....	....	....	....	....	....	·67	1·65	0 10 6
Seawood-ash		....	....	....	....	....	....	9·27	·49	·59	0 4 0
Ash of Kerosene shale		Hartley Vale	1·49	27 93	·70	·85	67·59	....	·28	·14	0 7 0
Cave deposit, shells, &c... ..		Cowan, Hawkesbury River.	2·11	....	·82	·99	....	35·40	1·59	·83	0 13 6
Cave-deposit		Macleay River	23·06	16·01	2·43	2·95	26·77	13·88	7 40	....	1 11 9
Gypsum		Marulan		(Crystallised CaSO$_4$ = 92·64.)			4·47	....	....	....	....
Flue-deposit		Maitland	....	....	....	....	83·75	2·56	·32	·31	0 2 0
„		Liverpool	....	....	....	....	91·17	·42	1·29	·17	0 2 6
„ from sanitary furnace		....	....	....	....	....	63·53	6·64	1·82	1·61	0 10 0
Night-soil preparation, "Pinhoe" manure.		....	·92	9·54	·21	·25	57·58	14·71	1·26	·56	0 9 6
Night-soil preparation, No. 1 ..		F. Artlett, Parramatta..	7·33	30·06	2·10	2·55	46·33	3·74 CaCO$_3$	1·92	·61	1 5 0
„ „ ..		„ „ ..	10·11	42·59	4·97	6·03	·94	30·12	·39	....	2 10 0
„ „ ..		Mr. Halstead, O'Brien's patent.	1·54	12·36	·54	·65	77·95	....	·63	....	0 6 0
Fowl-manure..		....	3·95	16·48	1·47	1·78	70·16	2·10	1·94	....	0 19 0
„		....	1·54	15·23	·86 *	1·04	79·96	·64	·59	·83	0 11 0
Bat-guano		....	14·11	17·69	1·55	·88	28·77	13·72	·†11·42	....	2 0 0

* 5 per cent. soluble in water. † 1 per cent. of the phosphoric acid is water-soluble.

A FEW SIMPLE HINTS FOR DETECTING ADULTERATION IN ARTIFICIAL MANURES.

It must be premised that it is of no use attempting the roughest analysis of a manure without a fairly accurate balance. The substances likely to be added as adulterants, or whose presence in quantity lowers the value of the manure, are not foreign matters, but those like sand which already exist in most manures; therefore, all attempts to decide the value of a fertiliser must depend upon an estimation of the quantities of the ingredients present, and these cannot be estimated without a balance which must be capable of weighing half a grain.

In the absence of a balance, however, the following rough tests may be found useful in giving an approximate idea of the purity of a few of the simple fertilisers:—

Bone-dust.—A good sample of bone-dust, however fine, shows the bony structure in some of the larger pieces. It should be as dry as possible, and in a fairly fine state of division. It should have the characteristic smell, though there is no need that the smell should be offensive. It does not follow that a bone-meal is necessarily good because the smell is disgusting.

Take about 100 grains in a small iron spoon or ladle; heat it strongly in a brisk fire. The heat should be applied cautiously at first to avoid loss by spurting, after which it may be heated as strongly as possible. Any moisture present, all the organic matter, and carbonic acid are driven off by this means, and the "ash" left behind contains phosphate and oxide of lime, and magnesia, with a small quantity of alkalies. This ash should be quite white if the bone-dust is pure, although it may require some patience and a pretty hot fire to get it white. This ash is now allowed to cool, and emptied into a glass beaker or a basin which will stand heat. If such a vessel is not at hand, a small enamelled saucepan may be pressed into the service. Pour into the ash in this vessel about half a pint of water and a few ounces of hydrochloric acid, and boil well for about five minutes. The substance should dissolve completely in the acid, or leave only a very small residue. If there is any considerable residue left undissolved, the presumption is that sand has been mixed either purposely or accidentally. Allow this acid liquid to cool; pour it off from the sand into a tumbler or glass jar. A rough indication of the quantity of phosphate of lime present may be gained as follows:—Add dilute solution of ammonia until the liquid smells of ammonia. This will form a dense white precipitate of phosphate of lime, and a little practice will enable you to judge from the bulk of the precipitate after it has stood for two hours of the relative proportion of this ingredient in the manure. If the same quantity (100 grains) be taken in each case, you will know what quantity to expect from a good sample. If no precipitate, or only a slight one is formed, the manure may be discarded. I know of no method by which even an approximation of the nitrogen can be made without apparatus. As sand is the most likely adulterant, it will generally be sufficient to test for it as above. This method will detect sand in bone-dust, dried blood, offal, and such products.

Sulphate of Ammonia should be a whitish crystalline powder, fairly dry and friable. It should dissolve completely in water without leaving any residue, and on placing some in the iron spoon used in the test for bone-dust, and heating it strongly in the fire, it should completely volatilise, leaving no ash. A fair idea of its purity may be inferred from the quantity of the residue thus left. A perfectly pure sample would volatilise completely, leaving the spoon perfectly clean. If a little of the powder be mixed with slaked lime, and heated in the spoon, a strong smell of ammonia will be given off. If there is none, the substance is not sulphate of ammonia at all, nor any ammonium compound.

Dissolve a little of the salt in water, and add a few drops of ferric chloride, which can be prepared by dissolving a little iron rust, scraped off a rusty iron implement, in hydrochloric acid. If a deep blood-red colour is produced by this reagent, the manure should not be used, as it contains a compound which is injurious to plants, namely, ammonium sulphocyanide. The solution of sulphate of ammonia should not alter the colour of blue litmus paper; if it turns red, the salt contains free acid and should not be used.

Kainit should be a crystalline powder, resembling common salt, more or less white, often of a reddish or darkish tinge, generally damp to the touch. It should almost entirely dissolve in water, and should be completely soluble in water to which a little hydrochloric acid has been added. The potash cannot be estimated by any simple method with any degree of accuracy.

The above tests require no other reagent than a little hydrochloric acid and ammonia, and though they are not, in any sense of the word, accurate analyses, still they may prove useful when there is any doubt about the purity of any of the substances in question.

With the help of a balance which will indicate half a grain, such as any druggist possesses, the following scheme will enable a fairly close estimation of bone-dust being made:—

The following articles and chemicals will be required:—A balance (turning to ½ grain), pure hydrochloric acid, pure ammonia, a packet of cut filter papers, glass beaker, pestle and mortar, a sieve of eighty meshes to the linear inch, porcelain basin, a glass funnel, some strips of litmus paper. These can all be obtained at the local druggists.

It is very important to obtain an average sample of the bone-dust. To do this, if the sample is contained in one bag, empty it out upon a clean board or floor, and mix it well with the shovel. If in two or more bags, take a sample from the middle of each bag and mix them as above. From this mixture take about a spadeful and grind it thoroughly in the mortar until the whole of it has passed through the sieve. The sifted sample is again mixed and is ready for analysis.

A piece of glazed writing-paper is placed on one of the pans of the balance, and exactly counterpoised by placing a similar piece of paper in the other pan. Weigh out exactly 200 grains of the finely-powdered manure upon the paper, introduce it without loss into the iron spoon, heat very gently at first and then gradually more strongly until the ash is white. Care must be taken not to lose any by spurting. Allow to cool; empty back again upon the paper without loss and weight. The weight should not now much exceed 80 grains. This is now emptied again into the porcelain basin, about half a pint of water added, and about three ounces of strong hydrochloric acid. Boil well for about five minutes, add a little more water, and filter.

Filtering is done as follows:—Fold one of the round papers in half , now fold again in half at right angles to the first fold On opening this out it will be found to fit exactly into the funnel. The funnel with the filter paper is now supported over a beaker. The liquid in the dish is poured through the filter, rinsing it out with water so as to get all the sand on the paper. The paper with the sand is now placed in the oven until quite dry, and weighed. If a second filter-paper be placed in the other scale the weight required will represent the weight of sand. This should not be more than 3 or 4 grains in a pure bone-dust. This number divided by two will give the percentage of sand and insoluble matter in the bone-dust.

The filtered liquid is now neutralised with ammonia—that is to say, ammonia is added till the solution turns red litmus paper blue. Allow this precipitate to settle and filter again in the same way as the sand; dry and weigh as before. The weight of this precipitate divided by two gives the percentage of phosphate of lime in the bone-dust. This should not be less than 40 per cent.—that is, the precipitate should weigh at least 80 grains. The above scheme does not pretend to scientific accuracy, but it will give a fair approximation to the actual composition.

As the efficiency of a bone-dust depends much upon the fineness of division, it is as well to grade it roughly by passing it through a sieve with twenty-four meshes to the linear inch. Three-quarters of the weight of the manure (75 per cent.) should pass through the sieve.

It must be thoroughly understood that the above tests are only intended as a rough guide as to the purity of a manure. If the quantity of impurity is found to be excessive a sample should be forwarded to a qualified analyst for his report.

General Remarks on Artificial Manures.

Manure the crop, not the land.

Never purchase a manure without a guarantee of its composition as determined by analysis.

In the case of complete fertilisers it must not be forgotten that you have to pay for getting them mixed, consequently it is often a question whether it would not be cheaper to buy the simple manures and mix them yourself.

The simple manures are bone-dust and superphosphates, containing nitrogen and phosphoric acid (superphosphates from mineral phosphates contain no nitrogen); dried blood, sulphate of ammonia, and nitrate of soda, containing principally nitrogen; kainit, sulphate of potash, and wood ashes, containing potash; and lime, gypsum, &c., containing lime. As these fertilisers are seldom used in greater quantities than can be mixed by hand the trouble involved is very small.

A further advantage is that you can vary the proportions to suit your own particular requirements in different cases, whilst in purchasing a complete fertiliser you nearly always pay for a quantity of some ingredient which you do not require.

As a general rule, the more insoluble manures are most beneficially applied in the autumn, such as bone-dust, dried blood, &c., the soluble fertilisers, being applied in the spring as a top-dressing.

This spring top-dressing it is best to apply in two or more portions,—the first dressing to be given when the crop appears aboveground; the second, and perhaps a third, after intervals of two or three weeks. Sulphate of ammonia should, however, not be applied at a late stage of the plant's growth.

It will be found more convenient to mix them with about three times their weight of dry loam, and distribute evenly. The advantages of such a course are obvious. Lime should not be added to ammonium sulphate, or dried blood, or bone-dust, as it drives off ammonia. It is safer not to add lime to any nitrogenous manure; hence, when the land has been limed, it is better not to manure it for two or three weeks.

Comparative Value of Farmyard Manure and Artificial Manures.

The following comparison of the relative manurial value of farmyard manure, and a typical complete artificial fertilizer may be found useful.

One ton of farmyard manure contains, roughly, the following quantities of fertilising ingredients :—

Nitrogen	8 lb.
Potash	6 lb.
Phosphoric acid	6 lb.

In 3 cwt. of the artificial fertilizer there are of :—

Nitrogen	9 lb
Potash...	6 lb.
Phosphoric acid	42 lb.

That is to say, 3 cwt. of the fertilizer contains about the same quantities of nitrogen and of potash, and seven times the quantity of phosphoric acid, as 1 ton of farmyard manure.

The cost of 3 cwt. of this particular fertilizer is about 19s. 6d.

The manurial ingredients in the artificial product are in a very soluble form, and their effect is more rapid. On the other hand, it contains no vegetable matter like the litter in farmyard manure.

Rotation of Crops.

By J. L. THOMPSON,

* Travelling Instructor in Agriculture.

Reasons for Rotation.

In McConnell's note-book the following nine reasons for rotating crops are given, and these I propose taking for my texts :—

No. 1.—It is more economical of manure, as different crops require ingredients in different quantities.

Now, it is well known that although plants require the same kinds of food to develop them, they draw it from the soil in very different proportions. For instance, chemists inform us that turnips remove five times as much potash per acre as wheat. Some crops draw their substance more largely from the air; some, again, more deeply from the subsoil. In this connection I submit the following from *Chambers's Encyclopædia,* in which will be seen at a glance the average weight of the principal ingredients removed per acre, in ℔., from the soil by the leading farm-crops, which will show the importance of growing these crops upon a carefully considered system of rotation :—

	Nitrogen.	Potash.	Lime.	(Phosphoric Acid.)	Silica.
Wheat—30 bushels	48	28·8	9·2	21·1	96·9
Barley—40 bushels	48	35·7	9·2	20·7	68·6
Oats—45 bushels	55	46·1	11·6	19·4	85·3
Swedes—21 tons	153	118·5	63·6	32·5	10·0
Turnips—17 tons	112	148·8	74·0	33·1	7·7
Mangolds—22 tons	147	300·7	42·9	52·9	17·9
Potatoes—6 tons	47	76·5	3·4	21·5	2·6
Beans—30 bushels	99	67·1	29·2	29·1	7·3
Clover-hay—2 tons	102	83·4	90·1	24·9	7·0
Meadow-hay—1½ tons	49	50·9	32·1	12·3	56·9

It is thus obvious that, by alternating the cereal, the root and the grass and clover—or leguminous crops—the producing power of the soil is more easily maintained and its exhaustion longer deferred.

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* Late Principal, H. A. College.

McConnell's second reason.—For the same reason as No. 1, it is more economical of food in the soil.

This reason has been fully dealt with in my remarks on No. 1; but I may add that the growing of one particular kind of crop is wasteful in the extreme, as one or more ingredients are drawn upon in large quantities, while other ingredients are accumulating, and giving no returns.

Examples of Rotations.

Rotations are called two, three, four, five, or six course, according to the number of years it takes to get through them.

1. *A two course rotation.*—Cereals and leguminous crops.—Lawes and Gilbert had extraordinary results from this course. One crop of wheat thus grown yielding more than two grown continuously.
2. *Three course rotation.*—Wheat, roots, clover, or leguminous crop of any kind.
3. *Four course rotation.*—Wheat, roots, barley, leguminous crop.
4. *Five course rotation.*—Wheat, roots, barley or oats, clover and grass for two years.
5. *Six course rotation.*—Wheat, roots, barley, or oats; clover and grass seeds sown same time; fourth, fifth, and sixth years in grasses. First year's grass generally cut for hay.

Generally speaking, I would recommend, where practicable, a five course rotation, as follows:—*Maize, roots, straw crops;* lucerne, clover and grasses or pulse for the remainder of the five years. The maize roots and straw crops could be grown within the limits of two years.

No. 3.—Rotation allows of a better distribution of labour on the farm throughout the year.

The system adopted by many farmers in these Colonies, of engaging a number of men to put in the cereal crops, and again to harvest them, and then discharging the workers to shift for themselves as best they can during the balance of the year, cannot be too strongly condemned. We hear a great deal about farmers being unable to procure competent farm-hands, but it is really not to be wondered at when the latter know that their services will be dispensed with as soon as the crops are all in the ground or harvested, as the case may be. There are many kinds of crops that could be grown with a fair chance of profit on a judicious system of rotation that would keep men and horses going all the year round. If the men were aware that their services would be permanent so long as their conduct was satisfactory, they would be satisfied with a lower wage, and would certainly take far more interest in their master's affairs. In a good system of rotation less cereals would be grown, and the labour of the farm would be more evenly divided over the whole year, instead of being spasmodic, as at present.

No. 4.—Allows of better cleansing of the land.

We have only to visit the old wheat-growing districts of the Colonies to see the dirty condition of the land from continuous cereal-growing. One crop year after year of the same kind gives no opportunity of cleaning the land, and bare fallowing and incessant working of the soil during the summer months have to be resorted to, which is not by any means profitable. With root-crops of any kind, such as Swedes, turnips, mangolds, beets, &c., sown in drills, the horse-hoe could be kept going so as to keep the weeds down and prevent seeding. Leguminous crops, such as peas, beans, vetches, cow-pea, clover, lucerne, and many other crops have a recuperative effect on the soil, and have a tendency to clean it.

No. 5.—A rotation of crops, deep-rooted or air-feeding crops, to enrich the top soil for the benefit of shallow-rooted varieties to follow.

Few will now question the statement that leguminous crops possess in a remarkable degree the valuable property of being able to accumulate nitrogen in the surface. This discovery is of the greatest possible value to the farmer in all parts of the world. The great experimentalists at Rothamsted, Sir John B. Lawes and Sir J. H. Gilbert, in their latest publications, state that there can be no doubt that in the growth in practical agriculture of leguminous crops, such as clover, vetches, peas, beans, sanfoin, lucerne, &c., at any rate some, and in some cases a considerable portion of the large amount of nitrogen which they contain, and of the large amount which they frequently leave as nitrogenous residue in the soil for future crops, is due to the fixation of free nitrogen brought into combination by the agency of lower organisms. Mr. Warrington says:—"The accumulation of nitrogen at the surface in the form of roots, stubble, and decayed vegetable matter is, in the case of a good crop of clover, sanfoin, or lucerne, so considerable that the whole of the above ground-growth may be removed as hay, and the land yet remain greatly enriched with nitrogen and in an excellent condition for producing a crop of wheat." Such crops as we have just mentioned, more particularly lucerne, send their roots deep into the subsoil, thus making innumerable perforations while storing up nitrogen, and when the roots decay they leave not only a generous supply of fertility for the following cereal crop, but millions of openings into which air and rain find their way, and help to constitute an unfailing store of fertility.

No. 6.—Some crops are a good preparation for others, as beans or clover before wheat, &c.

As already mentioned under head No. 5, leguminous crops are excellent preparatory ones for cereals, for by means of nodules or excrescences on their roots, which contain the micro-organisms concerned in the assimilation of free nitrogen, they leave the soil richer in that ingredient than it was before. Turnips, mangolds, beets, rape, potatoes, and other crops requiring a large amount of cultivation with the horse-hoe are a good preparation for maize, wheat, and other cereals. This ensures thorough tilth and alters the mechanical condition of the soil, encourages weathering oxidation, nitrification, and increases the amount of available plant-food.

No. 7.—Rotation checks the devastations of insects and fungi by changing the locality of the crops which they affect.

When insects or fungi infest any particular crop they are destroyed or starved to death to a great extent before that crop comes round again in the rotation. The conditions under which certain plants grow may be favourable to them, and the pests will increase if the same crop goes on year after year, but when these conditions are changed by an alternate system of cropping and cultivation they stand a good chance of being destroyed.

The following illustrations may be given in this connection. The potato-moths (*Lita solanella*), also attacking tobacco, are starved out if unable to obtain their special food. Turnips are also attacked by insects, which make them their special food—flea-beetle, for instance. Eelworms are very troublesome to some crops, whilst others are free from them. Careful rotation will tend to starve them out. Fungoid pests also notably affect only certain plants or groups of related plants, and any spores (reproductive bodies) will die unless within a reasonable time they meet with suitable host-plants.

No. 8.—A system of rotation of crops changes the locality of live-stock every year.

By this means there is an even distribution of the droppings of stock all over the farm. A judicious alternation of crops is as advantageous to stock-rearing as it is to the soil itself. It provides a greater variety of food, which conduces to the well-being of live-stock. Instances are on record that when turnips are grown frequently on the same land, and consumed thereon by sheep, the land is liable to become foul or stained, producing inferior roots, and the disease known as finger-and-toe; also that the sheep folded on them do not thrive, becoming subject to bowel derangement, often resulting in death, unless an immediate change of food and situation is provided for them. By being put through a course of cropping, and allowed to lie in grass for two or three years, the land is as fresh and sound for them as ever.

No. 9. A variety of crops are required for market and live-stock requirements.

It is generally recognised by intelligent farmers that it is not desirable to carry all the eggs in one basket, which is meant to imply that a variety of crops is necessary, so that in the event of rust in wheat, gumming in sugar-cane, blight in maize, &c., if grown solely, there will be a chance of other crops succeeding to prevent disaster. The growing of crops in a well-arranged rotation is one of the most effectual and lasting agencies for raising the fertility of the soil.

The great drawback to a complete system of rotation in the hot dry parts of this Colony, is the difficulty of growing root crops, more particularly turnips, but with the example of Mr. George Valder at the Experiment Farm, Wagga Wagga, before them, farmers should take courage, and may venture on the cultivation of turnips and Swedes during the winter months with success.

Rape can be grown where turnips would fail, and I have had great success with this crop in South Australia and in the dry north-western parts of Victoria.

The question may fairly be asked: How can the growing of rape without manure, and ploughing it in, improve the fertility of the land, seeing that nothing is added to it, but that is only restored to it which is taken out by the crop? To this inquiry I reply: The benefits of a rape crop, so far as I can judge, are as follow:—Science teaches us that a large proportion of the leaves and stalks of succulent herbage is composed of substances taken from the soil and atmosphere, such as moisture, carbon, nitrogen, &c. The roots of the rape plant permeate the soil, and draw to the surface from the subsoil valuable plant food. The rootlets improve the mechanical texture of the soil, and enrich it in their decay, and the whole plant, when ploughed in, decomposes, thus contributing considerably to the organic matter.

Conditions Modifying Rotations.

A perfect rotation should include those crops which the situation, soil, and climate of the farm will admit of being cultivated profitably. Distance from a market, the kinds of stock kept, soil and climate, the state of the land as to cleanliness, drainage, demand for various crops, and their market value, all to some extent modify rotations. The lease of the tenant sometimes affects the rotation.

Cross-bred Sheep and the Rotation of Crops.

A. BRUCE,
Chief Inspector of Stock.

The greatest want, indeed, the missing link so far as stock-raising and tillage are concerned—and these are without doubt the great producing interests of the Colony—is a profit-giving rotation of crops. Not only is this absolutely necessary to save our cultivated land from ultimate sterility, through continuous cropping without manuring, but it is equally necessary in order to ensure the two most essential requirements in a remunerative and permanent export trade in meat, *i.e.*, the meat must be of prime quality, and a steady and constant supply must be maintained.

It may, perhaps, be said that in some seasons it would be impossible to comply with these requirements. This is granted to a certain extent; but unfavourable seasons only occasionally occur, and we are a very long way from the position in which such an excuse for not making proper provision in the direction indicated can be accepted.

Where a reliable rotation, which includes the proper cultivation of the land, and the application where necessary of a fair quantity of manure, had not been followed, and the land has been under tillage for a good many years, it will not only not grow wheat to a profit, but the crop of oaten hay, which it now likely produces, is low both in quantity and quality, and will, if the present wasteful and ruinous system of cropping year after year without manure or cleaning be continued, become worse and worse through the deterioration of the soil and the large percentage of useless weeds that grow with the hay.

This style of farming—if it can be called farming—has all but ruined thousands of acres in the Campbelltown and Camden districts, where land which at one time yielded 20, 30, and even in some cases 40 bushels of wheat to the acre, now only gives an average return of perhaps half a ton of inferior oaten hay. Nor is there any wonder that this is the case, when we recollect that the land has been cultivated more or less every year for perhaps forty years, and seldom or never has any manure been applied to it, nor has it even been properly tilled.

The same sort of farming utterly impoverished millions of acres in the Eastern States of America, where, although scientific skill and capital have been again and again applied to it, and all sorts of manures been tried, the land cannot now be restored to anything approaching its original fertility.

It is true that in these colonies farmers in a good many instances, in order to prevent their land from being entirely ruined by continuous cropping, and as a substitute for manure, plough it up in spring, and allow it to remain fallow for two or three years. But soon after it is ploughed the land in ordinary seasons gets overgrown with weeds, which have to be got rid of by crowding the land with sheep; the sheep eat out the weeds, and in this way and with two or three years' rest, the land has so far recovered, when it is again broken up, and another, or perhaps two other crops of wheat are taken, after which it is again fallowed and the same process repeated. Any one, however, will see that this is a slovenly and wasteful style of farming, though better than keeping on year after year with continuous cropping, and one that must eventually lead to the complete deterioration of the land; while if it were properly cultivated, a moderate quantity of manure used where necessary, and a reliable rotation, such as that practised in New Zealand, of roots or other green crop, followed by cultivated grasses, were adopted, or if the land were laid down in lucerne, not only would its fertility be preserved but it would give very much better returns than it now does under the system I have here condemned.

What is wanted, therefore, more particularly in districts where crop after crop has for years been taken off the same land without cleaning or manure, is that a suitable rotation should be adopted and that a stop should be put as speedily as possible to this wasteful and lazy system of tillage, whether the occupier of the land be the proprietor or not. This precaution is specially addressed to those landlords who, for the sake of the comparatively high rents they have been receiving, are allowing their tenants to ruin the land. They should insist upon a proper rotation, though its enforcement should at first be attended with a somewhat diminished rent.

It would be well, too, that all those owners of land who are now allowing it to be cropped on terms should keep in view—as some of them are doing—the danger of cropping it year after year without a proper rotation; and if it cannot be let with that condition, they should take it again into their own hands and adopt a safe rotation of crops.

The place secured in the mutton export trade by the New Zealand farmers working under conditions of soil and climate much akin to great areas of this Colony, is the best argument that can be adduced in support of the general adoption of this profitable system. The following extracts from my report on the fattening of cross-breds in New Zealand will afford those intending to embark in the industry an idea of how the union of tillage and stock-raising is conducted:—

System of Farming—Combination of Stock-raising and Tillage Recommended.

(1) By the adoption of the system now all but universally followed in New Zealand of growing roots, green crops, and English grasses and feeding them off on the ground with sheep; or (2) by taking (say) two crops of wheat off new land, keeping it thoroughly clean, and laying it down with lucerne; or (3) by following systems (1) and (2), but assisting the crops with moderate quantities of manure.

Course (1) would be best adapted for districts such as New England, Bathurst, Orange, Goulburn, Braidwood, Queanbeyan, Monaro, Yass, Tumut, and the Upper Murray—that is, in the colder and more temperate portions of the Colony; and while course (2) would also be suitable for the alluvial land in the warmer portions of the districts mentioned, this course would, however, be specially adapted for the drier and warmer portions of the Colony where the subsoil is favourable. Lucerne growing has proved a great success in the country between the Billabong and the Murray. Course (3), again, might be followed in any portion of the Colony where the land will pay to cultivate.

If course (1) or (2) were adopted by owners, especially in the eastern side of the Colony where the country was adapted for it, they would be put in a position not only to breed and fatten large numbers of cross-bred sheep and lambs, and make them thoroughly prime at an early age, but they would also be able to do a great deal more than they now can in keeping up a steady supply of first-class sheep and lambs for export—a most essential matter for the success of the export trade in meat.

Above all, it would put our farmers and selectors in a position to breed and fatten cross-bred lambs, which, as a rule, pay better than sheep, and, in the long run, it would in most cases pay them best to consume their crops on the ground, with sheep which would thus manure it, and save it from being run out; or they might devote themselves entirely to buying store sheep and fattening them, which, under ordinary careful management, would leave a good profit where the sheep are really made prime.

Besides the reasons already adduced for the adoption of a reliable system of rotation, there is still another most important consideration for its adoption in the upland and colder portions of the Colony: it is, that the cultivation of the land would effectually free it of surface water, and besides growing nutritious food for the sheep, would thus remove what are now the seed-beds of fluke, worms, and foot-rot, and be the means of saving many thousands of pounds now annually lost to the Colony through the excessive, and to a large degree preventable, prevalence of these ailments. This will be evident when it is recollected that on a great deal of the land best adapted for tillage in the higher lying and colder portions of the Colony the sheep are notoriously subject to these diseases, and they are so mainly through the extensive tracks of really good land there having the hollows and gullies more or less covered with surface water, to which the sheep are enticed by the freshness and verdure of the grass, but where they not only get innutritious food, but with that the germs of the diseases to which allusion has been made.

While calling attention to the advantages of breeding cross-breds for export where the climate, land, and circumstances admit, I do not forget that Australia—and especially the New South Wales portion of Australia—is the great Merino wool-producing country of the world; that by far the larger portion of it is better adapted for Merinos than for cross-breds; and that there is every prospect of Merino wool advancing in price, while there is a likelihood of cross-bred being lower. But, although this is the case, it has to be borne in mind that frozen mutton can now (which it could not be some twelve or thirteen years ago) be nearly as easily put on the English market as wool, and that therefore it is a matter of the highest importance that our sheep-owners, with a surplus—in ordinary favourable seasons—of some four or five million sheep, should obtain a paying price for their frozen mutton. We have, however, to confess that, although our neighbours in New Zealand have for the last twelve or thirteen years been obtaining very remunerative prices for their mutton, we, as a rule, so far as our sheep-owners are concerned, have been exporting at a loss; and the reason is plain—we have not been shipping cross-breds, the only kind of mutton which, as a rule, makes paying prices in the English market; and this again has arisen through our sheep-breeders in country adapted for cross-breds clinging to the Merino for the sake of the wool and neglecting the production of mutton, which it is now quite apparent to those who have given the subject any consideration could be carried on in the portions of the Colony I have indicated with nearly, if not quite, as much success as in New Zealand; and if the agricultural settlement of the Colony is to be a success not only in the production of export mutton, but also of dairy produce, cultivated food must be grown to an extent not hitherto attempted. In other words, the marriage of stock-raising and tillage must take place, a consummation which the Department of Agriculture is so earnestly endeavouring to bring about.

Comparison of the land in New Zealand with that in the more temperate portions of New South Wales.

While in the alluvial flats of the Hawkesbury, the Clarence, the Richmond, the Tweed, and other rivers, and in the very deep rich deposits of black soil on Liverpool Plains, and other parts of the Colony, we have as good land in New South Wales as in New Zealand, or for that matter, perhaps, as any in the world, it may be that in the portions of this Colony in which the temperature and rainfall are best adapted for the growth of roots and cultivated grasses, we have very little, if any, country, possessing the fertility of soil which characterises the very best portions of both the North and Middle Islands, where the system is followed; but while this is the case, there are considerable tracts of country in the districts named, with suitable temperature and rainfall in which the soil is of a superior character, yielding in many instances 30 or 40 bushels of wheat to the acre, which even in New Zealand would be considered first-class; and we have again in the portions of the colony alluded to, at least two, and perhaps three other grades of soils which would compare favourably with the second and third rate soils in New Zealand, on which a rotation of grain and root crops and cultivated grasses is now successfully followed. For instance, taking New England we have—

(1.) The black volcanic soil with a strong tinge of red in it, giving, in favourable seasons, returns quite up to those stated, and frequently higher.

(2.) The less friable, but strong, somewhat black soil.

(3.) A sandy loam of a lighter or darker grey colour according to its fertility.

And it is believed that with proper tillage, and a little manure where required, or perhaps in some cases only lime, the least fertile of the classes of land mentioned, will, when properly worked, pay well under a rotation similar to that adopted in New Zealand.

Besides the portions of this Colony indicated as adapted for such a rotation as that followed in New Zealand, there are many other districts in which it will no doubt be adopted before many years are over.

The attached statement of temperature and rainfall of portions of New Zealand and New South Wales, kindly furnished by Mr. H. C. Russell, Government Astronomer, will afford an idea of the similarity that exists:—

Colony, and portions of Colony.	Temperature.	Rainfall.
NEW ZEALAND.		
Auckland (North Island)	59·5	41·799
Wellington do	55·6	50·117
Lincoln (Middle Island)	52·9	26·691
Dunedin	50·7	35·246
NEW SOUTH WALES.		
Uralla	58·2	35·800
Glen Innes	58·4	35·600
Orange	54·8	38·950
Goulburn	56·3	26·750
Tumut	58·5	37·730
Cooma	53·7	19·800

From this statement it will be seen that there is very little difference, if any, in the temperature and rainfall of the portions of the two colonies mentioned; and I have Mr. Russell's opinion that it may be safely said that the climate of these places is similar for agricultural purposes.

The suitability of New Zealand system proved by actual experience.

As there is in this Colony a large extent of country possessing similar climate and soil to those portions of New Zealand, where, under a proper rotation of crops, the owners are so successfully carrying on the breeding and fattening of cross-bred sheep—the same course can be followed in this Colony in the districts indicated; and on these grounds alone the owners in these districts should have every confidence in giving the system a trial; but after all it is not necessary that they should rely solely on the New Zealand experience; for although a proper rotation of grain, root-crops, and cultivated grasses has never been systematically tried in this Colony, sufficient has been done in growing turnips and grasses, more especially rye-grass and clover, to prove beyond all doubt that a rotation similar to that followed in New Zealand can be successfully adopted in the colder and more temperate portions of this Colony; and I make this statement not only on reliable information, which I have from time to time received, but also, so far as the growth of cultivated grasses are concerned, from what I have actually seen in several parts of New England, as well as what has been proved by experiments conducted at Wagga Wagga Experiment Farm where Mr. Valder has raised excellent crops of turnips.

Agricultural Seasons in New Zealand.

In May, June, and July oats and wheat are sown. The farther south the earlier. For wheat, 1¼ to 2 bushels. For oats, 2 to 2½ bushels.

In August—Oats are sown in the southern half of the Middle Island.

In September—Spring wheat is sown and oats may be still put in. English grasses, mangolds, and potatoes are put in during this month.

In October—Sow barley with grass seeds. Break up new ground and sow with turnips and rape.

In November—Break up new land.

In December—At beginning, breaking new ground; hay-making and turnip sowing.

In January—Fallow land to be worked; and that and barley crop to be attended to.

In February—Harvest month.

In March and April—Sow grass, with rape or turnips. Thresh grain, break up grass land for wheat, and cross-plough fallow land on to May and June.

Rotation of Crops.

A great deal of the land in New Zealand is suitable for rotation of crops, and the majority of the holders have adopted that system in some form or other.

It has only been by carrying on a proper rotation and by systematic farming that that colony has been able to keep up the heavy export of first-class sheep she has sent away, and maintain the fertility of the land.

On land which has been under cultivation, the usual rotation, followed in the best portions of the North Island and in the Middle Island, has been something like the following:—Land which has been (say) five or six years under pasture, and on which the cultivated grasses have been pretty well eaten or have died out, is broken up after lying fallow for perhaps three months, is cross-ploughed, harrowed with disc, and ordinary harrow, and sown with wheat, oats, or barley.

As soon as that crop is reaped and threshed, and the straw is stacked on the ground to be eaten by the sheep with the turnips, the land is ploughed, and afterwards, at the proper season again, worked, cleaned, and thoroughly tilled, and prepared for the turnip crop which is put in as afterwards described during November or December.

If the land is not very rich or nearly virgin soil it gets from 1 to 1½ cwt. of super-phosphates, or (say) 2 cwt. of bone-dust to the acre, which gives the turnips a start and insures a good crop. The turnips are eaten off with sheep in the end of autumn or in the winter; and, while the sheep are on the turnips, they are supplied with wheaten or oaten straw, or chaff, which they readily eat, and this, of course, is another advantage which a system of rotation secures, adding as it does to the weight and improving the quality of the mutton of the sheep if they are to be fattened, and increasing the carrying capabilities of the land if the sheep are only stores or breeding ewes. When the turnips are eaten off, the land is ploughed, and when sufficiently tilled and a good seed-bed formed for the grass seeds, it is sown with oats, barley, or wheat, and afterwards with the proper mixture of cultivated grasses and clovers for what is termed permanent pasture. If, however, the land is light, the second grain crop is omitted; and if very light, both grain crops are so, the land being prepared when the turnips are eaten off, and the grass seeds sown with the addition of a small quantity of rape or turnip seed.

The land, as thus laid down in grass, is allowed to be in pasture until the cultivated grasses again become too thin and require to be renewed, when the same course is followed; and where the land is fairly good the return from the grain crop alone goes a long way to repay the expense of the rotation, and that from the turnips and cultivated grasses leaves a considerable profit; while the growth of the leguminous plants (the clovers) supplies nitrogen to the soil, and this and the artificial manure put in with the turnips, together with that left by the sheep when eating them off, enables the fertility of the land to be well maintained.

Capabilities of the Land under Rotation.

Where the land is exceptionally good, the owner, following such a rotation as this, on breaking up the grass, gets, if the crop is wheat, from 33 to 45 bushels to the acre; and if it be oats his return will be from 60 to 70 bushels.

Next season, on land of that description, if it be at all a favourable one, and due care has been exercised in preparing the land, the turnips, with the usual allowance of chaffed hay or straw, will fatten from fifteen to twenty sheep to the acre.

The next season's crop of cereals (it is usually oats or barley) should be as good as the first grain crop, and with it the grass and clover seeds are sown. They are, of course, cut with the grain crop, but if the autumn is favourable they come again sufficiently to afford, with the stubble, a good deal of pasturage for sheep.

The next season, if the grass and clover have been properly put in, there is a strong, close growth of all the varieties sown, and the crop is either saved for hay or pastured with sheep, as the owner may decide. It is generally pastured, and land of the description alluded to should keep and fatten annually, for two years, six or seven sheep to the acre; where it is very good, but not exceptionally so, its carrying and fattening capabilities might be put at four or five sheep to the acre, and where only fairly good from two to three sheep, while taking the average capabilities of the whole Colony it is estimated that where the land has been fairly laid down in cultivated grasses, which are renewed every five or six years, they are carrying and fattening from two to three sheep to the acre.

Grasses and Clover.

Nearly all the English cultivated grasses and clovers grow well in New Zealand, especially on the moister land, where they retain their hold better and are green and succulent right through the summer, but, though moist, the land where grasses are sown should be properly drained—not at all water-logged. Where the land is at all good these grasses have excellent feeding properties. Even on comparatively thin soil, under proper tillage, and aided with small quantities of manure, they grow well and give good returns.

For some time the most of the grass, as well as the turnip seeds, were imported from England or Scotland, but now the greater part of them are saved in the Colony. So favourable is New Zealand for the growth and saving of these seeds that considerable quantities of some of the kinds are now exported to Europe, and it is believed that New Zealand is one of the principal sources from which Great Britain and Ireland now draw their supplies of cocksfoot seed.

The usual Mixture of Grass and Clover Seeds sown, and the Quantity per acre.

In New Zealand the following is the mixture of grasses generally sown, and the quantities of each, when laid down with cereals:—

Perennial rye-grass ...	25 lb.	White clover	2 lb.
Cocksfoot	5 lb.	Red clover	2 lb.
Timothy or crested dog's tail	2 lb.	Cow-grass	2 lb.
		Alsike	2 lb.

Where the land is dry crested dog's tail might be substituted for the Timothy, as it will not thrive in dry ground, or, instead of taking the crested dog's tail, the cocksfoot and cow-grass might each be increased 1 lb.

When sown without cereals, it is customary to add from ½ lb. to 1 lb. of rape or turnip seed to the mixture. These grow more quickly than the grasses and clover, and not only shelter them on coming through the ground, but supply the sheep with a full bite of early succulent and nutritious food. Of the two, the rape grows the more quickly than the turnips. Indeed, it is thought by some owners, too much so, to be made the full use of, and the turnips are now frequently preferred to the rape for this purpose.

Grasses sown in New Zealand.

Perennial Rye-grass.—Of all the varieties of cultivated grasses this is not only the most generally grown, but also that which forms the principal grass in the mixtures of seeds sown throughout New Zealand. Out of some 40 lb. of seeds, usually sown to the acre, there are generally as much as 25 lb. of rye. This grass, with a fair amount of moisture and temperate climate, grows on almost all descriptions of soil, even on stiff cold clay land and light stony soil deficient in lime, and on land where no other grass of value will grow; but the richer the land, if the drainage is good, the better and more permanent the rye-grass will be. It perpetuates itself in these cases both by seeds and rootlets. Indeed, on such land it may be said to be really perennial, but on soils of medium and poor quality it requires to be renewed from time to time (say) every four or five years.

There are none of the grasses so nutritious as the rye except the foxtail; and it is noted for the excellence of its herbage, the great weight of produce to the acre, its early and late growth, and the manner in which it stands the trampling of the stock. It is also especially valuable for the amount of food it yields during winter; and so well has it done in New Zealand that there is now a variety peculiar to the colony called the "Poverty Bay," which is found to be superior to any imported seed in standing and feeding qualities.

In 1891–2 no less than 864,511 bushels of rye-grass seed were grown in New Zealand. It is usually harvested by stripping, and the average yield on good land is from 15 to 20 bushels per acre.

In taking the seed the paddock is grazed till midsummer, when the stock are taken off for a few weeks and paddock shut up.

The price per bushel ranges from 3s. 6d. to 4s.

Cocksfoot.—This, with the exception of the rye-grass, is the most generally sown of all the cultivated grasses in New Zealand. It is a strong, hardy grass, and more than holds its own with other grasses and clovers. Indeed, it sees the most of them except rye-grass out—in some soils even that grass; and so much is this the case that, where the land is very good, considerably less than the proportion of cocksfoot given (one-eighth of the whole mixture) is put in, lest that grass should monopolise the land. It grows well on hillsides, where it is not so liable to run into tufts as on the flat land, and it shoots with every shower of rain. Where the soil is good, cocksfoot, when kept closely eaten down, is a good fattening grass, but if allowed to shoot up and ripen it becomes hard and comparatively innutritious, inclined to become bunchy or tussocky, and the stock, especially sheep, will not eat it unless actually obliged. In no part of the world does the cocksfoot do better than in New Zealand. It frequently goes 20 lb. to the measured bushel, while the standard is only 12 lb. Large quantities of this seed are now, as has been said, annually exported to Europe. It sells in New Zealand at from 3d. to 4d. per lb., and as much as 572,425 bushels were grown there in 1891–2.

Timothy.—Where the land is fairly good, the soil damp, and the climate at all moist, this grass, which makes very good sheep-feed, does well, and should in such cases always be in the mixture sown; but it should not be sown in dry country; but it flourishes in clay and moist soils, and is unsurpassed in peat. No grass will better bear extremes of heat and cold. It produces a heavy hay crop, and is exceedingly nutritious when young, and more so when old and seeded.

Crested Dog's Tail.—This is one of the chief British sheep-grasses, especially in upland districts, and is supposed to have a beneficial influence in preventing foot-rot. The sheep are very fond of the leaves, but, like the cocksfoot, it should be kept well eaten down, as the seed-stems become hard and the sheep leave them.

It thrives well in compact soil, and is very hardy. The roots are hard, and the plants are adapted to dry soils, and will withstand droughts.

It also does well in tenacious clay. There is hardly any soil it will not thrive in.

It is not much grown in New Zealand, and it is only suggested as a constituent part of the mixture where the Timothy has to be omitted.

Meadow Fescue.—This grass is considered by some authorities a very valuable one for permanent pasture on good land, but is not as yet very generally grown in New Zealand, and this may be accounted for through being liable to be affected with ergot, if it is let run into seed, and ergot acts as a poison on the stock.

The Clovers sown in New Zealand.

Perennial White Clover.—Has both fibrous and tap roots, which enables it to maintain itself in different soils. It grows best in mellow land containing lime, and on all clay soils rich in humus or gravelly clay. It forms an essential constituent in every good pasture, but is better for flesh than milk, and is of special service in fattening sheep. The white clover flourishes in New Zealand and keeps the hold of the ground very well—long into the summer—especially in the country where they have the limestone formation. Indeed, at times its growth is excessive, for it takes possession of the space which could be better occupied with other clovers or grasses.

Red Clover.—Is a strong plant, will grow on almost any soil, and contains a great deal of moisture. Winter and spring frosts are injurious to it. It is not very well suited for permanent pastures, but should form a proportion of an alternate mixture. Its great root growth during the two years of its existence is favourable to succeeding crops, carrying as they do nitrogen into the soil. It grows well in New Zealand, and now that the Humble bee has been introduced it has been fertilised and the seed saved.

In New Zealand it is generally sown with a spring cereal crop, mostly oats and barley, lightly grazed in autumn, and next year cut in November as hay giving from 2 to 3 tons to the acre.

The after growth is allowed to seed and ripens in March, when it is cut and threshed, giving from 200 to 300 lb. per acre, which sells at 5d. to 6d. per lb., or £10 to £11 per acre.

Cow-grass.—Is what is more properly termed the perennial red clover. It grows very well in New Zealand. It is an invaluable plant, and should be included in every mixture for permanent grass. Its roots reach well down into the subsoil, which enables it to obtain moisture in the hottest weather. Even in rather poor soil it produces a good quantity of succulent food. It stands the frost well, better than the broad-leafed red clover. The principal difference between the two clovers is that the cow-grass has a somewhat taller, smoother, and, except in its very young state, a less hairy stem, and has a stronger, less fibrous, and more penetrating root. It carries its flowers above its foliage, and surpasses the broad clover in succulence. Its stalks are generally solid, while those of the broad clover are hollow, and it produces less seed.

Alsike.—Is peculiarly adapted for damp soils, endures heat and cold well, will succeed in undrained clays better than any other clover, and is the only clover which will stand irrigation. For hay, alsike is superior to white clover, and for pasture produces more, and is eaten more readily; while it is more leafy and less pithy than red clover. Its nutrition is greatest at the flowering stage; and its value for pasture is very great. It flourishes in the same deep soil as Timothy, and does well with the other grasses mentioned in the mixture.

**Lucerne.*—The good qualities of this plant are too well known in New South Wales to require anything to be said here with respect to them, or to recommend owners whose land is adapted for its cultivation to sow it. In New Zealand, the grasses already mentioned have done so well and have so well suited the system of farming generally adopted in that colony, that comparatively little lucerne has been sown there; but where it has been tried it has answered quite as well in that colony as in this, and owners in the warmer portions of the colony are—now that wheat is not paying so well—turning their attention to lucerne, and a good deal more will now be grown there.

Bush Forest Land.

The expense again of laying down the bush forest land, which is, as a rule, heavier and better than the fern land, is much greater, as it is usually covered with trees, saplings, creepers, vines, scrub, and undergrowth. In preparing the land (the felling and scrubbing is generally done in the winter season) the creepers, scrub, and undergrowth have to be cut near the surface and overhead with a slash hook. After that the saplings and trees are felled, and when the whole is withered and dry, at the end of summer, or early in the autumn, the whole is set on fire, the aim of course, being to make the burning as complete as possible; for, with a good burning, the grass seeds which are sown in the ashes in the autumn come up close and strong, but it is otherwise if the burning is badly done, as the rubbish covers the land and allows the weeds to keep possession of the ground, thereby preventing the grass-seeds from obtaining a proper footing.

If the soil is good, and the burning successful, bush land treated in this way will keep three to four sheep to the acre, notwithstanding that it may for years remain thickly covered with the felled trees. In the course of five or six years, when the timber has become rotten, it is usual to "log up" and burn it off, principally with the view to cultivation, but sometimes merely for the sake of the pasture.

The felling, burning-off, seeding, and sowing an acre of bush forest land costs about 32s. 6d., the work being all done by contract.

There is no part of this Colony, except perhaps the rich scrub lands of our north-eastern coast country, where exactly the same system as here described could be followed by us; but I think that the same end would be attained at a comparatively small expense on the best portions of country, like that in the neighbourhood of Armidale, Guyra, and Glen Innes, by adopting some such course as the following:—To ring and kill the large trees, to grub out all the smaller ones, and having thus cleared the land sufficiently to admit of its being cultivated, to plough and work it till it is brought to a fine tilth, and then sow with some such mixture of grass and clover seeds as that given in this paper. In this way the seed would be put in as it ought to be, every grain would have a chance to germinate, and, if the season is at all favourable, a good growth of cultivated grasses would result at a comparatively small cost, which would last for at any rate five or six years, keeping from three to four sheep per acre; and when the larger trees and their roots had become rotten they could be taken down and burned, and the land cleared for fresh tillage.

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* An article on this subject appears page 185.

Laying-down land, which has been previously cultivated, with Grass-seed.

Preparation of the Land.—Whether the cultivated grasses are to be sown with cereals or without on land which has been cleared and tilled, those who grow them to the best advantage work the land on which they are to be grown in a thorough manner, so that there is not only a fine mould and good seed-bed on the surface, but they are careful that the soil, to a fair depth, is also well stirred by ploughing, cross-ploughing, disc, and ordinary harrowing, and rolling, the cost of which, at contract price, would be something like the following per acre:—

	s.	d.
Ploughing (say) 5 inches deep	5	0
Cross-ploughing (say) 5 inches deep	3	0
Disc-harrowing (say) 5 inches deep	1	0
Ordinary harrowing	1	0
Sowing cereals and grasses, and covering ...	2	6
Total	12	6

Time when Grasses are Sown on Land previously Tilled.—In the North Island and the northern part of the Middle Island the greater part of the grass-seeds are sown in the month of September, and some in the month of October. In the southern portion of the Middle Island they are put in from October to March.

Where the land is very cold, wet, and heavy, the later the sowing the better, and where the soil is light and warm the earlier the better; but of course the time of sowing must he regulated by the rainfall.

How Grass-seeds are Sown.—Where the land is rich, or has recently been manured, grass-seeds are laid down with barley, oats, or other cereal after a crop of turnips, which has been eaten off by sheep; and in other cases, which are perhaps the more numerous in the northern portions of the North Island, the sowing of the cultivated grasses follows directly on the turnip crop without any cereal.

Root Crops.

TURNIPS.

The turnip crop in New Zealand is a very important one. According to the Statistical Register for the colony, there are nearly half a million acres under that crop.

Turnips on Tussock Land.—In breaking up tussock (new) land for turnips after the tussocks are hoed up and burned, the seed is generally sown in November or December broadcast, to prepare it for future crops; and if well laid down, and in a fairly favourable season, the yield is good, nothing suiting the turnips better than virgin soil; and after the turnips are eaten off by sheep the land is properly tilled and a grain crop taken.

Turnips on Cultivated Land.—Supposing it was intended to crop land from which wheat had been taken with turnips, and that the land had been broken up in April and allowed to lie fallow till the end of the following August or September, it would then be cross-ploughed and worked, cleaned, and prepared for turnips, which are sown in the months of November or December.

The following statement of the work done in laying down turnips is moderately heavy, and the cost at present contract prices per acre are here given:—

	s.	d.
Ploughing and cross-ploughing	6	6
Disc-harrowing once or twice each, at 1s. ...	2	0
Harrowing with ordinary harrows	1	0
Seed and sowing, including rolling and covering in one operation	1	6
	11	0

In former years turnips were sown broadcast with cannister machines, and where they came too thick the harrows were run through them. They are now sown principally in drills with machines which sow the seed and at the same time apply (in front of the seed) about 1 or 1½ cwt. of bone-dust or other fine manure to the acre. This system brings on the young plants much more quickly, and thus protects them from the fly; and still another improvement is for the drill to water (which some machines do) the land into which the seed is dropped.

If the sowing is well managed no thinning nor hoeing is necessary, but if they require it a scuffler or grubber is drawn across the drills to thin out some of the plants, when the turnips grow in bunches of three and four.

While the cost per acre in this way is a moderate one, fair to very good crops are got. They run from 15 to 30 tons per acre, on which, with the addition of some chaff, from ten to twenty sheep per acre are fattened, and double that number of growing or store sheep or of ewes can, with what grass they can get, be wintered and kept in good condition for those classes of sheep.

Instead of nets, as used in England, temporary wire fences are put up in the field to portion the turnips off to small lots of the sheep, and make them eat the roots up clean as they go.

The turnips-seed sown are generally (1) A small quantity of Devonshire grey stone (a soft quick-growing white turnip) for the sheep to commence with; (2) Aberdeen yellows, both purple and green-topped; which form the principal portion of the crop; (3) A few acres of Swedes are occasionally put in, but Swedes, though very fattening and good keeping turnips, are too liable to be attacked by the fly to be grown in any great breadth. They have to be sown in prepared drills, and cleaned, and hoed as in England, which entails more expense than owners generally care to incur.

The object for which the turnips are grown is of course to fatten sheep, and they answer the purpose admirably, especially as they are now usually helped with oaten or wheaten chaff. This is supplied in large portable water-tight feed boxes set on wheels. As much as twenty or more sacks of chaff can be put at a time into one of these boxes, from which the chaff falls through a narrow opening at the bottom as required into the feed troughs fixed under the boxes, the roof of which extends over and protects them from wet. In this way the sheep have a continuous supply of fresh chaff, and they are at the same time provided with rock salt.

Spring wheat, oats, or barley usually follows turnips, and the grass and clover seeds are sown with these cereals. When a grain crop is not taken after the turnips the grass and clover seeds are, as already stated, sown with a small quantity of turnip or rape seed.

Catch crop of Turnips.—It suits very well at times when land is in good heart to put the scarifier through a stubble field in the end of February or part of March and sow it with turnips to put the lambs on in the end of autumn or beginning of winter. When a crop can be got in this way it is a very great help to them.

MANGELS.

Considerable breadths of mangels are grown in some districts. They are a more costly crop than turnips, as they must be sown in prepared drilled land and hoed; and they are not so suitable for cleaning the land as turnips, as sowing does not commence till November, which gives ample time to destroy the weeds. This is lost with mangels, which must be sown in October.

The great advantage in mangels is their keeping property. They have only reached their primest condition when the turnips are exhausted, and they besides contain a greater amount of nutrition. They are invaluable for stud sheep. Mangels are only sown in rich land, and heavy crops are got with proper cultivation. From 30 to 60 tons per acre are not uncommon.

Green Crops.

RAPE.

This is the principal green crop in New Zealand, and fattens well in certain seasons. Although it is somewhat subject to blight, it forms a very valuable change of food for the sheep, and is, of course, of special value for lambs, coming as it does in the end of autumn and periods of the year when the pasture as a rule is dry and scanty. It is sometimes sown on a first furrow as a chance crop, when, if it succeeds, the benefit is great, and if it fails it is not a matter of much moment, as the outlay is small, for 10 lb. of seed will sow an acre, and the price is only about 3d. per lb.

When sown as a catch crop, as it generally is (say) after wheat or some other cereal, the scarifier is put through the land immediately the crop is harvested, and before the surface soil is hardened by the action of the sun. The land is then well harrowed and brought to a fine tilth, and the seed can be sown with a seed harrow the same as lucerne. Instead of using the scarifier some use the skim plough. The seed should simply be rolled in, and not covered too deeply.

The rape is also sown early in spring, and coming well up as it does before the grass, it is a great help in districts where the winters are rather severe and long.

In light land spring sowings of rape answer best, and on heavy land autumn sowings do so.

Rape, as already mentioned, is also largely sown with cultivated grasses, as it adds very much to the amount of food grown, and while being eaten off by the sheep the young grass plants get safely trodden into firm ground, and the manure left by the sheep greatly benefits the pasture.

Where the turnip crop has failed through the fly or any other cause, rape could be sown, and the loss which otherwise might have resulted can be to a great extent averted.

OATS.

More particularly the Dunn oats are sown as a green crop, and after they have attained a height of 4 or 5 inches are eaten down twice, and, if the land be very good, even three times before they are shut up for the grain crop.

This is done in two ways:—

(1.) The land is ploughed (say) in July or August, allowed to be fallow until the following February, and then cross-ploughed, or scarified, harrowed, and sown; or

(2.) As soon as the grain crop has been taken off (say) in the month of February, the land is ploughed or scarified and harrowed, and the oats sown.

RYE.

It is also sometimes grown as a green crop.

WHEAT.

Wheat put in early is frequently dealt with in the same way and eaten down once, and sometimes twice if the land is good and the season a fairly favourable one; the yield of grain is increased, and a considerable amount of succulent food is obtained for the lambs, which helps them to stand the winter better.

CAPE BARLEY.

Is sown to some extent for sheep, but more for dairy cows and horses. It is extremely hardy, and comes early to maturity. Sown in March it is ready in May, and it may be pastured twice at least till the beginning of October, when it is shut up and a crop of 40 or 50 bushels of barley reaped.

Cross-breeding can be adopted on some of our Natural Pastures.

Although the return from cross-bred sheep kept on the natural pastures would neither be so large nor so early as under a system of root crops and cultivated grasses (while sheep that are kept under that system are sold as fat at twenty-two months, those depastured on natural grasses would have to be kept for, perhaps, six or eight months longer), there is no doubt but that cross-breeding can be successfully followed in the best portions of that part of the colony known as the Western Slopes—including the lower-lying hilly, and undulating thickly-grassed country on the west side of the Main Coast Range, commencing at the line where the New Zealand system of sheep-farming and tillage cannot be successfully adopted in this Colony, and extending westward from the mountains to the plains. But the country in which cross-breds will thrive has a wider area than that. This has been proved by the fact that a good many owners have of late years been breeding and fattening cross-breds successfully on the natural grasses in portions of the Colony where the climate is warm, the rainfall light, and where it was considered cross-breds would not answer.

The country I allude to is such as that extending from (say) Inverell to Moree, from Liverpool Plains to Wee Waa, from Dubbo to Warren, from Cowra to Forbes, from Wagga Wagga to Groongal, and from Corowa to Moama. The fact is, that if the land is good, the pasture plentiful and nutritious, the water supply sufficient, and the breeder knows his business, cross-breds do well in even comparatively warm country.

All these conditions are called for in the case of any kind of sheep, if they are to give good returns, but especially so as regards cross-breds; and although it may not appear a matter of very great moment, the water supply is with them of special importance; for even in the temperate and colder portions of the colony cross-breds require a great deal of water, and not only so, but they must not be made to travel far for it if they are to lay on condition as fast as they ought to do; while, however, this is the case, with plenty of water they can come through a drought nearly as well as the Merino, and with the return of good seasons and sufficient grass, if the land is good, they lay on condition faster than the Merino. At the same time the safer course would be to only breed cross-breds in the more temperate and colder portions of the Colony.

Then again, the fencing ought to be thoroughly secure. It should be cross-bred proof from the commencement. If cross-breds are once allowed to get through a fence it will be next to impossible afterwards to keep them within bounds.

Experience has proved that nothing less than an eight-wire fence with one batten between, if the posts be no more than 8 ft. apart, and with two if they are 12 ft. or even 10 ft. apart, can be relied upon.

Of course in the portions of the Colony here indicated, although root crops and cultivated grasses usually sown in New Zealand cannot be grown, lucerne can be sown where the soil is suitable (and it is so in a great deal of the country here indicated), to great advantage, and would in that case to a large extent supply the place of the root crops and cultivated grasses and clover grown in New Zealand; for not only does lucerne in suitable soil produce as much, if not more, hay of excellent quality than rye-grass and clover per acre, but it can with ordinary care be successfully pastured with sheep; and if the land is really good and the crop an average one, the owner, by dividing the sheep into small flocks—making the paddocks small—and regularly shifting the sheep before the lucerne is too much eaten down, as many as eight, ten, and even twelve sheep can be fattened to the acre. This is very encouraging and is still more so when it is considered that the area within which lucerne can be successfully grown has recently been proved by actual experience to be much more extensive than was supposed.

Many owners are now growing lucerne successfully on land which has little of the character of alluvial about it.

Description of the Breeds of English Sheep.

THE LINCOLN

Is a large strong-boned sheep. It has a somewhat large head, and it is a characteristic of the breed to have a tuft of wool on the forehead. Its form and shape as a mutton sheep are good, and it has the shoulder and back well covered. It fattens very readily on rich pasture, but the mutton of the pure breed is coarse if the sheep are allowed to reach anything like maturity. The fleece, as regards length of staple, lustre, and weight, ranks very high, good pure-bred stud rams clipping from 14 to 17 lb., and some high-class sheep as high as 20 lb., and pure-bred ewes from 10 to 12 lb., of soft lustrous wool.

Among the recommendations of the Lincoln crosses may be mentioned:—

(1.) Where land is good, the country sound, and the grass plentiful and nutritious, or where they have sufficient cultivated grasses and turnips, the Lincoln crosses do remarkably well.

(2.) They come earlier to maturity, and are heavier weights at 12, 18, and 24 months than any other cross, weighing from 55 to 65 lb.; while the mutton—when the sheep are prime and killed they weigh from 55 lb. to 60 lb.—is good both in appearance and quality.

(3.) The Lincoln crosses have heavier fleeces, and, as a rule, their wool brings a better price per lb., on account of its length and lustre, than that of any other cross, except perhaps the Border Leicester.

Among the objections brought to this cross, the following may be mentioned:—

(1.) They do not thrive well on middling or inferior country, nor where the feed is scanty or of inferior quality, nor where they have far to travel to water.

(2.) Their constitution is not so robust as those of the other crosses, and where the circumstances are such as to induce lung or other worms, or, indeed, any other ailment, they are more likely to be affected than other crosses. They cannot stand much wet without suffering.

(3.) The percentage of lambs is somewhat less, and the loss of lambs in lambing is said to be greater than in the case of other crosses, on account of the comparatively large head and strong bone of the Lincoln rams.

THE BORDER LEICESTER.

In the pure sheep, the head, though rather wide between the eyes, is comparatively small and light behind the ears. The face, which has no tuft, is white, and the head is bare well back behind the ears. This sheep stands rather high on the leg and is light in the belly, but has a wide chest, well-sprung rib, long body, broad back, and good depth of flesh; and with its good form and shape and small bone the Border Leicester is an excellent butchers' sheep.

The wool is fairly long and soft, in little locks, and not very open, but rather scanty on the belly and legs. The pure bred stud rams clip 9½ lb. to 10½ lb., and exceptionally good rams 12 to 13 lb.

The good qualities of the breed for crossing with the Merino are said to be:—

(1.) It is a vigorous robust sheep with good feet, and the crosses do well on anything like good country, and come to maturity early, sheep which have been well kept weighing 65 lb. at twenty-two months old.

(2.) The fleece is a good profitable one, though not so heavy as that of the Lincoln cross.

(3.) The head being small and bare and the bone fine, the losses in lambing when the Border ram is used with the Merino ewe are said to be less than in the case of the Lincoln.

(4.) The adaptability of the Border Leicester to the circumstances.

(5.) Its high position, both as regards the appearance and quality of the mutton. It is believed that the high price of the Canterbury mutton is largely owing to a large proportion of the sheep being of the Border Leicester first cross.

The objections taken to the Border Leicester are:—

(1.) It stands too high on the leg.

(2.) The fleece is light compared with the Lincoln, and when the Border Leicester rams are used beyond the one cross there is a very large falling off in the weight of the fleece and length of the staple, and there is also a falling off in the quality of the mutton.

(3.) Although the head of the Border Leicester is not so large, the width of the chest and largeness of the shoulders of this breed are said to cause a good many losses in lambing.

ENGLISH LEICESTER.

The English Leicester is the smallest of all the Leicesters, and has been the most improved (by Bakewell) of any of the long-wooled breeds, so much is this the case that it has been used to bring a good many of the other English breeds of sheep to the advanced position as regards aptitude to fatten and early maturity, which they now occupy. In the pure sheep of the English Leicester breed, the head is smaller than that of the Border Leicester, the face is white with a blue tinge, the bone is very fine, the hind-quarters are often rather small, the temper is mild, the aptitude to fatten great, and the maturity early. The mutton, if the sheep are killed between twelve and eighteen months, is fairly good, older than that it is greasy and inferior. This breed carries a fairly heavy useful fleece.

The crosses of this breed have to recommend them:—

(1.) Their compact well-shaped carcass.
(2.) Their small bone.
(3.) Their aptitude to fatten.
(4.) The comparatively heavy fleece for their size.
(5.) The less risk of death in lambing, through the smaller size of English Leicester rams.
(6.) The suitability of the cross to middling and even inferior country.

The objections to this cross are:—

(1.) They do not come to the same weight at the same age as the Lincoln and Border Leicester and Romney Marsh crosses.
(2.) The mutton is not so good even as the Lincoln, through being inclined to be too fat and gross, and its lack of red flesh.

THE ROMNEY MARSH OR KENT SHEEP.

Professor Wallace describes the Romney Marsh as a hardy, good-milking, active sheep, well suited for hilly pasture. Its face is white, and it resembles the Cheviot in general appearance. Like a good many of the other English breeds, he says the Romney has been improved by the introduction of English Leicesters. Its forehead is broad, and it usually, though not always, carries a forelock. It is especially distinguished for compactness of form and strength of bone. It crosses well with other breeds, and its mutton is of the kind in demand in the British markets.

He describes the wool of this breed as being of good quality, and the fleece the densest of all the longwools. Mr. Roberts, again, has not a high opinion of the wool of the pure-bred Romney, which he says runs off very much in quality in the breech.

The qualities which recommend the use of rams of this breed for crossing purposes are:—

(1.) Its hardiness, and the power of resisting to a great extent the attack of worms, fluke, and foot-rot.
(2.) The weight and density of the fleece.
(3.) The weight and quality of the mutton of the cross.
(4.) The suitability of the Romney ewes, through being good milkers, for breeding fat lambs for market.

The objections which have been raised to the use of this breed for crossing are:—

(1.) It is rather low in early maturity.
(2.) The want of sufficient covering of flesh and fat on the loin and back, but especially on the top of the shoulder, which even in good specimens of this breed is higher than the back.

THE SOUTHDOWN OR SUSSEX.

This is the breed through which all the other downs have been improved. The head is small, and closely woolled on and up to the ears (naked ears are objectionable) and on the forehead. The face and legs are of a grey-brown colour.

The Southdown is very short on the leg, broad in the chest, round in the barrel, particularly good in the hind-quarters, and altogether very compact and symmetrical in form and shape, deeply fleshed, and well covered all over, especially on the back and rump. The mutton is excellent and brings top price, but the fleece is short and light, ewes only clipping from 3 to 4 lb., and crossed with the Merino the return of the wool is so low, both in quality and quantity, as to lead owners to be very shy of using rams of this breed for crossing, although the mutton, both in appearance and quality, is the very best. The Southdown rams and Merino ewes make excellent fat lambs, but even for fat lambs some of the other Downs, if Downs are to be used (the Shropshire, for instance), answer about as well, and, if any of the drop are to be put again to the ram, much better, as regards both weight of carcass and weight of fleece.

THE SHROPSHIRE DOWNS.

This breed was established by crossing the local breed with the Southdown for quality, and then introducing the Leicester for size and length of staple.

The face is longer and larger than the Southdown, the nose is slightly Roman, and the ears larger and more lively. The face and legs are of a blackish-brown, more inclined to black, and usually tinged with grey round the nose, eyes, and jaw. White on the face or legs, or black spots in the fleece are objectionable.

The Shropshire, like the Southdown, is excellent in form and shape, and somewhat heavier, and the crosses of this breed with other English breeds or even with the Merino, when sold as fat lambs, pay well, but kept till they are older the return is not so good, either in weight of mutton or wool, as the Leicester cross. The quality of the mutton, especially in the Shropshire and Merino cross, is excellent both in appearance, shape, and flavour.

The fleece of fairly pure-bred Shropshire ewes should average from 7 to 8 lb.

The Shropshire stand very high as regards percentage of lambs.

THE HAMPSHIRE DOWNS.

This breed has a strong resemblance to the Shropshire, except in the matter of the fleece and wool, which in the Hampshire is not nearly so saleable as the Shropshire, and, besides, is only about half the weight. For this reason alone the Hampshire is not a desirable breed to introduce into this Colony.

The Views of the New Zealand Breeders as to which is the best English Sheep for Crossing with the Merino.

THE LINCOLN AND MERINO CROSSES.

The opinion in New Zealand is that on rich, sound, well-watered pasture, where the feed is abundant and nutritious, the Lincoln is the most suitable English breed for crossing with the Merino, for in such a case these crosses give the best return, taking into account both wool and mutton. But to do this they have to be kept going on good feed and plenty of water from the time they are dropped till they are fit to slaughter. Then, again, the increase of the Lincoln cross is more affected than most of the other crosses by too much wet, by middling or inferior pasture, but especially by deaths in lambing.

As sheep to breed from, the ewes of the Lincoln and Merino crosses through their good frames and excellent fleeces, are superior for that purpose to any other, provided they have been reared in sound country and are free from worms.

THE BORDER LEICESTER AND MERINO CROSSES.

On rich pasture or other nutritious food give nearly as large a return in weight of mutton as the Lincoln cross, and of a better quality and form.

The Border Leicester crosses, while standing well as regards early maturity, are hardier than the Lincoln, and will thrive on even middling country. They generally, too, adapt themselves better to the circumstances in which they are placed than the Lincoln, or perhaps almost any of the other crosses.

Then again the well-bred Border Leicester ram gives his progeny width of chest, rotundity of frame, and depth of flesh, and they handle particularly well on the rump, loins, back, and shoulder, while the first cross mutton is excellent.

The weak point in the Border Leicester is the comparative lightness of the fleece and lack of covering, especially on the belly and legs. It is said that these crosses cut 1½ lb. less than the Lincoln; but it brings a fully higher price. Unless, therefore, the breeder can put Lincoln rams to the ewes of the Border Leicester cross, it is not deemed good management to breed from them, as it is certain that a considerable loss in weight of wool would follow the use of the Border Leicester rams a second time, and also loss of quality in the mutton.

THE ENGLISH LEICESTER AND MERINO CROSSES.

Sired as they are by sheep which stand fully as high as any breed in aptitude to fatten and early maturity, these crosses on real good pasture make, perhaps, better progress than those of any other cross, and they do fairly well on middling and even poor country, though as lambs and weaners the sheep of this cross are less hardy, and the annual increase from the cross is less than in the case of some of the crosses. On the other hand, through the fineness of the bone and the smallness of the head of the English Leicester ram, the losses in lambing in this cross are very low, and help to make the annual increase an average one.

Although rather light in the hind-quarter, these crosses are like their sire short on the leg, and so far as form is concerned, make very shapely carcasses; but the mutton even when young is not first quality, and brings a second-rate price; and when the sheep are thoroughly well done to, and kept for over twelve months, the mutton is apt to be gross and greasy.

The fleece of the cross is heavy for the size of the sheep, and of fair quality.

This cross is not in much favour in New Zealand. It is not high in stamina, but it is believed that the principal cause of its unpopularity is that it is not liked by the freezing companies.

THE ROMNEY MARSH AND MERINO CROSS.

On rich land these crosses do nearly as well as the Lincoln, and quite as well as the Border Leicester so far as increase of weight is concerned, and although the carcass is not so well shaped as the Border Leicester, the mutton is nearly as good, and somewhat better than the Lincoln cross. Like its sire, the Romney Marsh cross is much less liable than some of the other crosses to foot-rot, and fluke, in wet country, but it does not thrive so well unless the pasture is both nutritious and plentiful.

While the mating of the Romney Marsh ram with the Merino ewe is fairly successful as regards the mutton, the cross is even more so in the fleece—the wool of the cross being comparatively dense, and of good quality.

The percentage of increase in this cross is high; this arises from the fecundity of the Romney Marsh, and also from the large supply of milk which the cross ewe gives—a characteristic of that breed.

The ewes of this cross are good mothers, and can be put either to the Lincoln or Border Leicester rams with fair prospect of success.

THE SOUTHDOWN AND MERINO CROSSES.

The objection to the Shropshire crosses apply with still greater force to the Southdown as a sire, as the wool in that cross is lighter and more inferior, and the carcass also weighs less, but at the same time the quality and flavour of mutton is very high, and the lambs of this cross, if prime, bring the highest price per lb.

THE SHROPSHIRE DOWN AND THE MERINO CROSS.

This makes an excellent butcher's sheep, as the carcass is short, compact, broad on the back and loin, round on the shoulder, and deep fleshed, while the mutton is of prime quality and flavour.

On good pastures these crosses do well, although in aptitude to fatten and early maturity—except while lambs,—they do not quite come up to the Lincoln or Leicester crosses; but the high character of the mutton makes up to a great extent for any shortcomings in these respects.

It is in the wool that this cross, like all the other Down crosses, fails, although in a less degree than the others; and the deficiency in the weight and quality of the wool is so marked as to lead breeders to refrain from putting Shropshire rams to the Merino, except in special cases, or for a particular object, such as breeding for fat lambs for market, for which the Shropshire is peculiarly well adapted, the lambs of this cross coming early to maturity, being fair weights, and superior both as regards appearance and quality.

THE HAMPSHIRE DOWNS AND MERINO CROSSES.

These crosses have the advantage of large size, shapely carcass, and good mutton, but the fleece is very poor, both as regards quality and weight.

It is only right to notice that all the Down breeds are noted for large percentage of lambs.

Changes of Breeding according as the Standard of Mutton or Wool requires to be raised.

Although in New Zealand owners, as a rule, use the different breeds of English sheep according to the class of country on which the sheep are kept, and according to the rules here mentioned, there frequently comes a time when they require to raise the standard of their flocks, either as regards their wool or mutton; and in such a case if it is the weight of the fleece that calls for increase, and the country on which the sheep are running is sound and good, the owner would, as a rule—whether his flocks are Border Leicester, Romney Marsh, or English Leicester, or any of the downs—most probably put Lincoln rams to his ewes; while, if it be the carcass which requires improving, it would, no doubt be the Border Leicester ram which would be used. For instance, if in the first cross with the Merino ewe the Border Leicester were used, the progeny would be comparatively light in the fleece, and if the whole of them, both ewes and wethers, are not to be fattened and killed, but some of the ewes kept to breed from, then the owner would put a Lincoln ram to these ewes once or twice, according to the nature of his country; and afterwards, perhaps, return to the Border Leicester or some other mutton sheep to maintain the character of his sheep for freezing and export.

With respect to the sheep which makes the most saleable mutton in the home market, it is believed that the first cross out of the Merino ewe by a ram of one of the English breeds (say), the Border Leicester, or the Shropshire or Southdown, would, both here and at home, sell the most readily and bring the best price. As to the most saleable weight again, that has altered very much, and in direction which gives us greater hopes of an improvement in the price of our Merino mutton in England; for while the sheep sold in London in 1882, which realised 6½d. per lb., averaged 80 lb., the most saleable weights have from that time gradually fallen till they now range from 55 lb. to 60 lb. This is a state of things which will suit our breeders well, as first crosses out of Merino ewes by English rams will, if fairly well cared for, reach the required weight at a much earlier age than the Merino now does.

The fact of the first cross being so saleable in the London market will suit our sheep-breeders, who are thinking of taking to cross-breeding, in another important respect, as it will enable them to put that system to the test in such a way as they will not run the risk of upsetting that which as breeders of Merinos they are now following, until they can see how the cross-breeding will answer. For they can for a few seasons put the English rams only to their old ewes, take the last crop of lambs as cross-breds, and if they think fit fatten off the whole of the progeny, or sell them as stores, or breed from them, according to the result.

This will answer well in yet another important respect. The English rams should be put to old and not to young ewes, as the losses in lambing with the English rams are much heavier when young, especially when maiden ewes are put to these rams. It is only right, however, to say that the general opinion that old ewes give better lambing has been called into question by some of our most experienced breeders, who prefer to use maiden ewes.

The Advantages of the Crossbreds stated shortly are:—

1. Prime Crossbred mutton is worth in England more than 1d. per lb. than prime Merino, and that on a 60-lb. wether is 5s. at least.
2. Taking the age when a Merino wether is usually sold, *i.e.*, four years, the Crossbred, by being prime at two years or under, in that time gives a return of about 120 lb. prime mutton and two skins, and the Merino only 50 lb. and one skin.
3. The Crossbred suffers much less in a low or glutted market than the Merino.
4. The breeding of Crossbred fat lambs pays very much better than breeding Merino lambs.
5. The by-products of the Crossbreds are much more valuable than the Merinos; and
6. By breeding Crossbreds, and supplementing the natural pasture with cultivated food, a successful rotation of crops can be established, and the deterioration and exhaustion of the soil now going on by continual cropping without manure prevented.

Irrigation.

By CLARENCE H. GORMAN,

Manager, Pera Bore Experiment Farm.

The question as to whether irrigation will be carried out or not must be decided with regard to several conditions—first, the average rainfall of the district; second, the character of soil; third, situation of land; fourth, the kind of crop desired. To sum up the four conditions, it may be said that local experience will guide. As long as good crops are obtained with natural rainfall little concern need be paid to irrigation; but if rainfall is uneven and crops show distress after careful attention, then it would be well to provide the facilities for irrigation. The mode of bringing the water to the site to be irrigated depends entirely upon local conditions and the means at one's disposal.

The first thing to be remembered in regard to irrigation is to have the land thoroughly graded, so that water can be applied economically. Then the water is taken to the highest point, and permanent head-drains made, and from these drains the water is distributed in the furrows.

Some people advocate a fixed quantity of water per acre. This cannot be done in many cases. Trees themselves will show when enough water has been applied, as in the same way they will show when they require the water. But this can only be learnt by practical experience. Irrigation by fresh furrows is the most prevalent, both in America and Australia. The old system of always running water down the same furrow has been shown to be detrimental to the growth of trees, as at the same time the moisture cannot be retained. Fresh furrows should be run on both sides of a row of trees, and the water allowed to run slowly from eighteen to twenty-four hours, according to the nature of the land. As soon as a horse can stand on the land that has been irrigated the cultivator should close in the furrows, thus retaining the moisture and keeping the land in a well-stirred condition. It is only of recent years that people are learning that the more cultivation the less likely the land is to dry out. When not cultivated, land bakes and cracks, thus allowing all moisture to evaporate through the cracks. By cultivation these cracks and pores are closed over, and the moisture is retained where it should be. Success may be safely said to depend on the moderate use of water and incessant cultivation.

Orchards.

In a young orchard irrigation should be carried on fortnightly for the first three waterings, then at intervals of a month throughout the summer. As the trees age it will be found necessary to use more furrows, and water only every six weeks, allowing the water to soak well in each furrow after it has reached the end of each row. Never shut the water off when it gets through. So many make that mistake, the result being that the trees at the top of the row are well watered and those at the end not watered at all. Let the water run slowly, soaking all the time.

Water must be prevented coming in contact with the trunk of the tree or the stem of any small crop. "Mal di Goma" in citrus trees is caused by water lying about the trunk of the tree, and many other diseases originate from stagnant water. Thus it is wise not to plant too low trees that are to be irrigated. Go in for thorough deep soaking, without flooding. Do not irrigate too late in the season; it prevents the proper dormancy of trees or vines. The trees store enough nourishment during the growing season to tide them over the winter.

Many growers go in for a system of basining round the trees, thus checking the flow of water, and giving a greater chance of soaking, but it must be borne in mind that basining does not mean flooding round the tree. The land around the tree must be high, so as to prevent the water lying round the stock. In making head-drains there is some doubt as to how much fall should be given them. This depends upon the amount of water which it is desired to carry and the acreage of land to be watered. It may also depend on the nature of the soil in which the head-drain is constructed. A strong flow in soft land means much washing out and removal of top soil. However, if the land is to be irrigated by one main head-drain, the fall of the drain can be arranged according to the fall of the land. Having all the necessary appliances for irrigation, only practical experience will tell "how to irrigate." To some it comes quickly, and there are some to whom the art of irrigating would always be as a stranger. The main point to be remembered is to regulate your supply of water so that it runs slowly, soaking all the time.

Never rush water; no advantage is gained. Where there is a big fall it will be found well to use sluice-boxes to regulate the water from the head-drain to the furrow. A sluice-box is usually made of red-gum timber, 3 feet long and inside measurement of box 4 in. x 4 in., with a tin sliding-cap in the head-drain end. These are put in the drain opposite each row of trees.

A great loss of water is sometimes experienced by "seepage," a soaking through the banks of drains. This can be prevented by cementing or piping, but in doing so, care must be taken to have the outlet boxes in the proper places, otherwise a considerable amount of extra work will be necessary.

There is a system of sub-irrigation which, however, is not often practised. Where only a few trees are to be attended or a man has plenty of time, it may work; but never on a large scale. The idea is to bring the water immediately to the roots. When the tree is planted, a layer of sand 1 inch deep is put on the bottom of the hole. In the sand place a piece of 2-inch piping, 1 foot long. Over the sand place the soil that was originally removed, and plant the tree in the ordinary way. Fill the pipe with gravel, so that when withdrawn the gravel will remain where the pipe was. When the water is poured in it will percolate through the gravel and sand, and distribute itself among the roots. As mentioned before, this could not be carried on to any extent, and could only be worked by those with a few trees. Drainage must be taken into consideration. If there is no proper get-away for the water, the result will be detrimental to the growth of the tree in this way, that the water will be held in the soil until evaporated from the surface, preventing cultivation, and at the same time injuring the roots. Improper cultivation, added to the boggy state of the ground, will make the soil dry out, so that the wettest soil in winter will be the driest in summer, no matter how the water is applied. Thorough drainage means the surplus water in winter is removed, and moisture retained in summer. Where soakage is bad an outlet for waste water must be found in just as efficient a manner as for receiving the water.

Lucerne.

My experience under this heading leads me to believe that the best system is by flooding in ½-acre checks. The checks should be made level, and banked round, with an outlet at one corner leading into other checks. After levelling, the land should be thoroughly watered, and when dry enough, cultivated so as to make a good seed-bed for planting. When the lucerne is about 6 or 8 inches high water should be again applied, but only in a sufficient quantity to give the plants a fresh start. I would also recommend the use of a light harrow until the seed has a good hold of the land, and afterwards the Planet Jr. cultivator may be used. Avoid flooding the young plants too much. Too much water is as bad as too little. The best results are obtained by planting in drills, from 5 to 10 lb. to the acre. The advantage of sowing in drills is that systematic cultivation can be carried on, and, if desired, irrigation by furrows also practised. The latter system is as follows:—The drills are planted 12 inches apart, furrows are run down every fourth drill, and the water allowed to soak the distance between. This will be found to be a much longer system of working, inasmuch as furrows have to be opened and closed each watering, and the ground is not kept perfectly level, as required. I strongly favour the ½-acre flooding system, but would not recommend more than ½-acre checks being laid out. Care must be taken to water evenly. Do not allow more water to lodge in one place than another; this of course will depend entirely upon the grading of the checks in the first place. In irrigating cereal crops the system adopted is to run furrows every 6 to 8 feet, after the seed is sown, and when the crop shows signs of distress to run the water slowly to the end of the furrows in exactly the same manner as referred to previously.

Cereals.

The irrigation of cereals has not been gone into very extensively for this reason: Farmers say they are quite content with growing in districts where the rainfall is sufficiently large and evenly distributed, without going to the trouble of commencing in other districts where irrigation is necessary. However, I contend that where the facilities for irrigation are obtainable the crops will increase in returns where the water is properly applied. I have seen magnificent crops on the Murray (I refer to wheat) grown under irrigation, and also a case may be instanced where a farmer in the Bourke district has obtained a larger yield per acre under irrigation from artesian boring than under ordinary conditions in the Riverina.

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Conservation of Fodder.

ENSILAGE.

THERE are several ways of carrying out this excellent method of conserving fodder, and the accounts now published concerning the systems that have proved successful in this Colony and elsewhere are taken from articles on the subject that have appeared in the *Agricultural Gazette.*

A good deal has been said as to the value of silage, and in some instances its importance has been over-estimated; but the following evidence, extracted from an article on Winter Food for Dairy Cows by Mr. J. L. Thompson, Travelling Instructor in Agriculture, will show what people who have tried ensilage think of it:—

A circular was issued by the Department of Agriculture of U.S.A. to 4,000 farmers, asking them to report on the value of silage. Not one said a word against it.

The following are some of the replies:—

1. "It will double the stock-carrying capacity of our farms."
2. "It gives a vigour and healthy appearance not seen in hay-fed cattle."
   "We can double the stock, thus increase the fertility and value of our farms."
3. "It enables one with a little land to keep a large amount of stock."
4. "We believe stock can be kept for one-half the cost of other food, and will fatten as well as during the best grass season."
5. "Anything of vegetable nature that animals will eat will make useful ensilage."
6. "Forty or 50 tons of fodder can be ensilaged off 1 acre, which is worth more than 20 tons of hay."
7. "The cost of feeding on ensilage as against hay and roots is 1 to 3."
8. "I think cattle can be kept for one-fourth the expense of any other method."
9. "One acre of ensilage will keep eight head of cattle 100 days."
10. "I am keeping four times the number of stock with my silos than I have been able to do hitherto. A silo filled with green fodder in time of protracted drought is invaluable."
11. "The profits are very large."
12. "Silage I believe to be the dairyman's anchor, especially on expensive land. I would as soon think of doing without a house as without a silo. I farm for profit, not for pleasure, and have found the silo the best investment I ever made."

Mr. Walter Madden, ex-Minister of Lands of Victoria, says: "The same 50 acres of green stuff that would produce 100 tons of hay at a cost of about £1 per ton for the making, would produce 300 tons of silage at 2s. per ton for the making, and the 300 tons of silage when made would be worth at least double the amount per ton that the hay would be worth, either for fattening or milk-production, and worth many times as much as a summer fodder for cows. A cow cannot eat more of the silage than of hay in a day."

A Victorian farmer, writing to the press, says: "Hay is not to be mentioned in the same breath as silage. I think 1 ton of silage is worth 3 tons of hay for milk-producing. Horses are also very fond of it. I am going to make another silo, and convert all my crop into silage."

Mr. David Wilson, another Victorian: "I made a silo, and filled it with green wheat and oats, and 10 acres of Scotch thistles, all chaffed. It was a complete success, the cattle eating it well. Butter made from it secured 1st and 2nd prizes at the local show."

"Freehold" writes in the *Australasian*: "The fact that silage is good, and the conclusion that it would be specially valuable during the dry Australian summer, need be no longer disputed. It is a fact that in stack silage the loss is only trifling as compared with the gain in the cost of procuring the cured fodder; moreover, it is found that stacking in sheaves is a very convenient method, the reaper and binder being brought into requisition."

A writer in the *Argus* says: "Some years ago Mr. A. Dunlop, a well-known cheese-maker, was living on the Harewood Estate, near Tooradin. About that time he pitted some green maize for silage. Several months later he found it had rotted on top, and thinking the whole spoiled, left it undisturbed. Mr. Dunlop having left, Mr. F. Greaves took over the farm, and recently found, on examining the silage, that although 1 foot on top had rotted away the remainder was in perfect condition, showing that the method is valuable for storing the surplus of good seasons even for years, thus providing a valuable reserve to fall back upon in times of scarcity."

Mr. Alexr. Crawford, Manager of the Victorian Government Travelling Dairy, in a lecture on this subject in 1889, says: "To give you some idea of the comparative value of hay and silage, take one instance. Ten tons of green fodder equal 3 tons of hay, and 10 tons of green fodder will make within a fraction of 10 tons of silage. Few beasts will eat more than 56 lb. of hay per day, and they will eat about the same weight of silage; thus the hay would feed one beast for 120 days, and the silage for 400 days; and during that time the silage beast will milk better than the hay-fed one."

Mr. M. Burke, of Woodstock, Victoria, speaking of the immense value of silage, says: "Some years ago I ran my milch cows—about 150 head—on 1,600 acres of grass land; recently I have only used 600 acres, but have grown silage crops, and I find that I can keep as many cows, and in better milking condition, on the 600 acres, with the use of silage, than I formerly did on my 1,600 without it; and if silage had not come under my notice I certainly could not have continued to go on dairying profitably."

Mr. James Bell, of South Australia, says, in a letter on the subject, after detailing the proceedings necessary in providing silos and silage: "The result of all the outlay has been this: The milk produced by silage is richer in cream, butter is sweeter and of a better colour, and the cost of feeding on silage is about one-half as compared with bran and chaff. Bear in mind I am not telling you what *can* be done, but what I *have* done, and what the result has been. Twenty tons of silage would go as far as 20 tons of hay. If 20 tons of green stuff be dried, we only get 6 or 7 tons of hay.

"There are also other advantages arising from the use of silage. When in a pit it is safe from fire and flood; in the stack it is safe from fire. The harvesting is done early, when labour is most easily obtainable, and the land can be early ploughed and scarified and exposed to the summer sun.

"In June, 1891, I wrote to the local paper pointing out the value of the system for this district, and where, during the year mentioned, much inferior hay was made, or, perhaps, I ought to say good hay was spoilt owing to almost continuous wet. The haymaker can make hay only when the sun shines; the silage-maker can harvest the crop in any kind of weather, even in heavy rain; and if this crop is rather old the silage will be all the better for the wet."

The spotted or variegated thistle makes capital silage. Of it, Mr. Featherstonhaugh, of Goorianawa, writes that three stacks of about 800 tons in all, from a small area, were completed at a cost of about £110. Stock eat it greedily; 3 lb. per day will keep a sheep alive and in good heart. There is an exceptionally large amount of mineral matter in this plant, much of it salt, a point considerably enhancing it value.

Silage was the subject of a special report by the Victorian dairy expert, Mr. Wilson.

He said, amongst other things: "That at present many butter factories and creameries have to be closed for four months in the year simply because there is no food for the cattle. Silage would supply the food required at a time when the market price of dairy produce is at its best. We have to import butter from New Zealand. Plentiful supplies of good silage would obviate this, and, in addition, would reduce the evil consequences of a drought."

The Board of Agriculture in Great Britain, in one of its leaflets published in 1893, refers to the great value of silage both in respect of being able to save wholesome food for stock during periods of excessive wet and also for tiding over periods of drought.

Hiram Smith's reply to the question, "What is the probable future of silage in the U.S. of America?" is as follows:—"I venture the opinion that the thoughtful, the observing, the progressive dairy-farmer will depend almost entirely on silage made from Indian corn for both summer and winter food, while the old fogey summer dairyman will continue to keep his cows on pasture only, and howl at monopolists, railroads, tariffs and taxes, take his wife into town sitting on a board across the box of a lumber waggon, and if she timidly asks him for a dollar, he will sneeringly ask her, what she did with the fifty cents he gave her last week. Can I honestly advise a small farmer to go to the expense of building a silo? Yes; as readily as I would advise a farmer to buy a seeder, a self-binder, and threshing machine." It may be stated that Mr. Hiram Smith makes over 3,000 tons of corn silage per annum.

It has been pointed out that silage is, as a form of food, in a better condition for digesting than hay. The latter is dry, and, after being eaten, must be considerably softened ere its nutrition can be useful. Silage, on the contrary, is soft and saturated with moisture, so that it is easily masticated, and the process of digestion and assimilation can commence at once, and before it has passed through the stomach most of its available nutriment has been assimilated.

In practice, says one writer, it is found that a crop of fodder of any kind converted into silage will support three times as many animals as the same crop would do if made into hay, and five times as many if they were turned out to graze upon the crop.

One great advantage in connection with making a crop into silage is that there is practically no waste, whereas in turning it into hay much loss occurs owing to frequent handling, as the leaves and stems becoming brittle, break, and many particles fall away.

It may not be generally known, as pointed out by Dr. A. P. Aitkin, that bracken fern, so common in some districts as to be positively detrimental to the grass, is remarkably well adapted for silage, possessing a very high percentage of nitrogenous matter, in which respect it compares favourably with silage made from clovers. Sheep eat it greedily and thrive on it. The all-important matter in making bracken-silage is that the plant must be cut young, before the curl is off the leaf, the fern being of no use for silage if cutting is delayed until the fronds have expanded, as they have then become hard and leathery. One other point, a high temperature, must be attained in the stack to make good bracken-silage.

It is needless to say more on this aspect of the question. There is undoubtedly a concensus of opinion with regard to silage to the effect that it is a most valuable form of food for stock, and is indispensable in a country situated like our own, where seasons vary so much, and in consequence the stock of available grass fluctuates considerably, whilst its preference to dry food for milch cows is beyond question.

SILOS.

*Location and Construction.

Silos may be pits dug wholly underground, constructions built either partly or entirely above the surface of the ground, or, as is now very generally practised, mere silo stacks put up like an ordinary rick of hay, and then pressed. In many cases some old barn or farm building is utilised and converted into a silo, with results equally satisfactory.

In the case of a specially-constructed silo it is desirable to have it as near as practicable to the feeding-place. In the case of stack silos, on the other hand, it is often convenient to build them out in the field where the crop has been growing, so as to save the carting of bulky and loose material, and to feed the stock subsequently, either in close proximity to it, or else cart the silage to them in its more compressed form, at a time when both men and teams are generally less hard-worked on the farm.

A mere hole or pit dug in the ground is the simplest form of silo known. These give good results when the soil is dry and sound. They consist simply of a pit, in which the maize, sorghum, tops of sugar-cane, or any sort of green fodder, is laid horizontally in the direction of the length of the pit.

The walls should be as near as possible perpendicular to ensure the better settling of the stored fodder, and when the level of the ground A B has been reached, the green stuff is still heaped on regularly, and is gradually brought to a point, as shown by the section of the triangle A B F.

After having allowed the mass of fodder to subside somewhat for a day or two, it is covered up by means of shovels, with a layer 20 inches thick of the loose excavated earth.

The earth must be well trodden, more especially at the sides A B, where decomposition, resulting from access of air, is usually noticed in the silage. The steady and continual compression brings on a corresponding subsidence and further shrinkage in the bulk; any cracks which may occur during that

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* J. A. Despeissis, M.R.A.C., *Agricultural Gazette*, Vol. III.

period are patched up directly they are observed. No other covering is required, and the earth may be kept from contact with the green fodder by means of a thin layer of straw scattered over the surface.

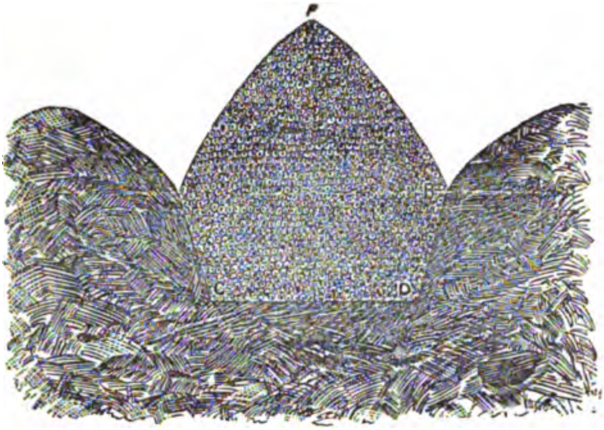


Fig. 1.—Earthen Pit.

When there is a rise in the ground, and a cutting or trench can be very economically dug by means of a plough, followed by an earth-scoop, the waggons, with their load of green stuff, are driven along it, and their contents emptied as they move on; the trench being filled up in successive layers, which settle gradually under the trampling of the animals and the weight of the carts. A considerable quantity of fodder has thus been saved and preserved at a comparatively trifling cost, and has turned out as good silage as any made in more elaborate structures.

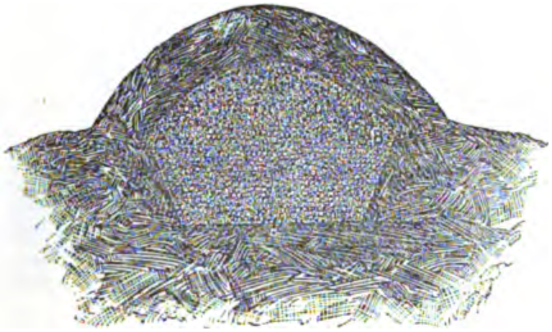


Fig. 2]

Whenever the soil is damp, or is subject to being water-logged or flooded before the fodder has been entirely consumed, the silos are constructed *above* the surface of the ground. In that case the green stuff is heaped up and well trampled down in the form of a pyramid, on a piece of ground (Fig. 3), the surface of which, if found necessary, may be raised so as to stand above the line of floods.

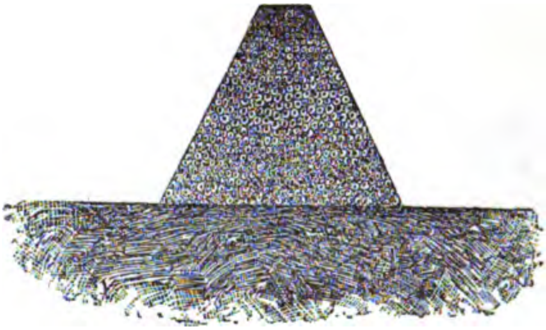


Fig. 3.—Earth Silo constructed aboveground.

The earth necessary for covering up the green fodder is obtained from the lateral ditches V and Y (Fig. 4), which are opened all round the silo for the purpose of collecting and carrying away the surface water.

With care and proper attention, good fodder may be preserved in these earth silos, their great advantage being simplicity and moderate cost of construction; but the number of failures in securing the proper preservation of the succulent crop show, on the other hand, that it sometimes happens that want of proper attention may lead to much damage being done to the fodder. These silos are often wasteful, on account of the leakage through the soil, and the impossibility of entirely excluding air.

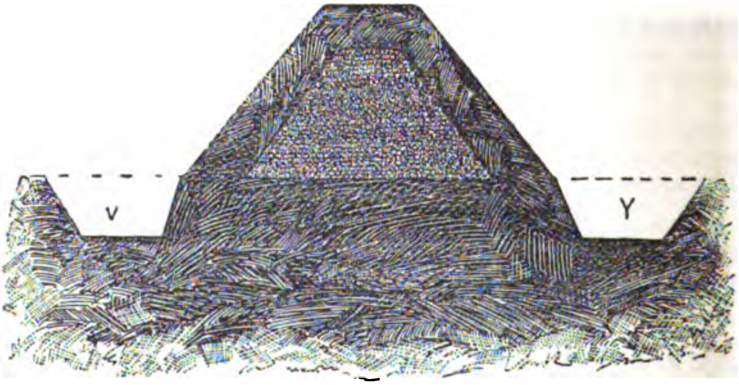


Fig. 4.

A silo properly constructed should be air and water tight. It is convenient to have it built partly underground, and for that reason when especially built (Fig. 5), it should be constructed on a slope or bank, so that the carts can approach it from the upper side and tip their contents into the silo, which can thus be filled from above, while the silage can be withdrawn at the lowest point.

The walls need not necessarily be very thick, experience having demonstrated that the lateral pressure of the silage is not so much as might be expected. In order to facilitate even filling and packing, and the consequent exclusion of air, it is essential that the walls should be plumb and smooth, and that the corners be rounded. Slabs of wood or lumber are in many instances the cheapest and best material for silos, and, when compared with brick and stone, give the most satisfactory results.

There should be no drains to carry away the fluid that is frequently pressed out, as there is always danger of admitting air through the drains, which causes loss in the feeding value of the material.

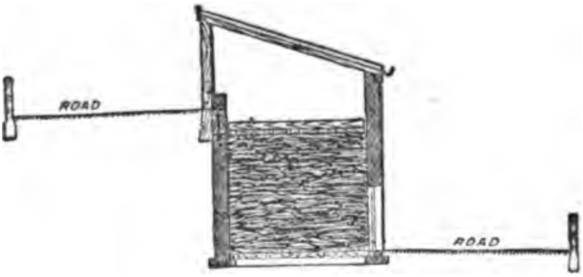


Fig. 5.

Speaking on the subject of this primitive pit system in 1889 before the Royal Commission of Vegetable Products in Victoria, Mr. J. L. Thompson, then Principal of the Dookie Agricultural College, said:—

"In January, 1888, we had such a superabundance of green maize that the cattle could not consume it before it got much too dry and woody. The silos at the farm were full of chaffed barley and vetches, and I was at a loss to know how to preserve this valuable fodder. The idea, however, struck me to pit it in the same manner as potatoes, &c., in the old country. I, therefore, started a team of horses with a plough and earth-scoop, which very quickly excavated a trench 30 feet long, 10 feet wide, and 2½ feet deep. The loose earth was left at the sides, thus forming a trench fully 5 feet deep. At this juncture the maize was cut close to the ground, carted direct to the pit, and packed lengthways in the excavation some 5 feet high. After all was completed the scoop was again used to put the earth on the maize (no straw or covering of any kind was used); the horses crossing over the heap helped to consolidate the mass. The earth was brought to a point so as to throw off water, and care was also taken to make a plough furrow round the pit to carry off surface water. The trench was opened by scraping the earth off with the horse scoop, and the maize was found to be in a grand state of preservation—it fact, no waste at all. The cows consumed it with much avidity, and, considering that most of them had been a long time calved, gave large quantities of milk of excellent quality."

In 1893, during May, a temporary pit was excavated in a piece of rising ground in one of the Hawkesbury Agricultural College paddocks, with scoop and bullocks. Over 100 tons of white ensilage corn and sorghum were carted into this pit, the drays being driven over the mass with each load, so as to consolidate it. The earth was used for weighing and covering the silage, and was brought to a fine peak to throw off the rain. The pit was opened in August, and the silage found to be in splendid condition. It was of great service to the milch cows during August and September, the only drawback being that it was not chaffed.

The method employed by Mr. Alex. Hay, Coolangatta, is described in the *Stock Journal* as follows:—"The question of ensilage is an important one to every owner of stock, whether on a run, farm, or dairy-farm. Feed for the winter and bad seasons, other than the growing grasses, is imperative in these go-ahead times, and silos fill the bill. Most of the delegates to the Hawkesbury College no doubt saw the fine silos there, and noticed the splendid ensilage in them. However, they cost money, and every grazier and agriculturist isn't overdone with 'splosh' in these times, so it is necessary to know how to make a silo without going to any expense beyond that entailed by labour in the ordinary way on a farm. Mr. Alex. Hay, who manages the great Coolangatta Estate, furnishes us with the particulars of a silo he had constructed at Coolangatta. He had a stack made on the side of a hill for a bed, and stacked until sufficiently high to cart from above. The total quantity put into the stack was 1,800 cartloads of green maize just at the cobbing. Each cartload weighed about 15 to 17 cwt. 'After the stack was trimmed and squared up I put about 6 inches of bedding straw on top, and then laid on ordinary split rails, or any flat timber that I could get, over that. I then had carted about 3 feet of earth upon top for weighing it down. The result is an unqualified success.' Total cost, about £155, or 2s. 1¾d. per ton."

Mr. J. L. Thompson examined a sample of this silage at the Berry Show, and found it in as good a state of preservation as any silage he has ever seen.

Size of the Silo.

The size of the silo should be proportional to the number of cattle to be fed, and it is better to have it too large than too small. One cubic foot of silage (about 45 lb.) per head of cattle per day is a good ration, in conjunction with some other food, provided the animals are turned out for grazing besides; this is the basis on which the size of the silo should be calculated.

When the animals are kept in stables, a more liberal ration should be given, and a good milking ration is 6 per cent. of their live weight, with the addition of a few pounds of concentrated food, such as bran, oats, maize meal, or lucerne hay; so that ten cows weighing 1,000 lb. each will consume 600 lb. of silage daily, or 18,000 lb. per month, or 72,000 (32 tons 2 cwt. 96 lb.) in four months.

If the weight of 1 cubic foot of silage is reckoned at 45 lb., 1,600 cubic feet of space would be required, to which, if the silage has been well packed, about one-sixth should be added in allowing for shrinkage; so that altogether provision should be made for 1,866 cubic feet. Besides this there is always a small percentage of waste, which should be taken into account. Supposing 5 per cent. is allowed on that head, a silo having a total cubical content of 2,000 cubic feet will be required, which capacity will be given by a silo 20 ft. x 10 ft. x 10 ft. deep, inside measurement.

As a hay-barn, this silo, supposing 1 cubic foot of hay weighs 7 lb., would hold 6 tons 5 cwt.; but it has a capacity equivalent in feeding value to 10 tons 14 cwt. 3¼ lb. of hay, estimating 3 tons of silage equal to 1 ton of good hay.

It is reckoned, that 1 ton of green stuff gives a little less than the same weight of silage, so that to supply the 32 tons of fodder required to feed ten cows, kept in a stable for four months, 3 acres of a crop cutting 11 tons of green stuff to the acre are required, or only two acres of a crop cutting 16 tons, such as maize, sorghum, sugar-cane tops, &c., and if the cattle can go out grazing, one-third more could easily be kept on the produce of the same area of ground during the same period of time.

Should a great number of stock have to be fed, it is advisable to partition off the silo into receptacles having a capacity of 2,000 to 3,000 cubic feet each, for the convenience of filling, especially if different crops have been grown for this purpose, as it is desirable to fill each silo with one sort of crop only; in feeding off besides a smaller surface is exposed to the air, and the fodder is not so liable to become mouldy in consequence of that exposure.

It will often happen that farmers or stock-owners will either be willing to sell or buy silage, which, like hay, is a marketable commodity. The following rules will be found useful in measuring and valuing the contents of stacks.

One cubic foot of silage weighing on an average 45 lb. it follows that 50 cubic feet will represent the capacity of 1 ton of preserved green stuff.

With a tape measure the length and breadth, then the height to the eaves, and the perpendicular height from the eaves to the top. To calculate the quantity proceed thus:—

Rule.—To the height from the ground to the eaves add one-third of the height from the eaves to the top; multiply this sum by the breadth, and that product by the length. This will give the contents in cubic feet. Divide this by 50 to bring it into tons.

Suppose a stack of silage is 20 feet in length, 12 feet in breadth, the height to the eaves 10 feet, height from the eaves to the top 6 feet. Required quantity in cubic feet and in tons.

$$\left.\begin{array}{r l} 10 & \text{feet height to the eaves.} \\ 2 & \text{feet} = \tfrac{1}{3} \text{ of height to the top.} \end{array}\right\} \text{add}$$

$$\begin{array}{r r l}
 & \overline{12} & \text{feet.} \\
 & 12 & \text{,, breadth.} \\
 & \overline{144} & \\
 & 20 & \text{,, length.} \\
50\ ) & \overline{2880} & (\ 57\tfrac{3}{5} \text{ tons.} \\
 & 250 & \\
 & \overline{380} & \\
 & 350 & \\
 & \overline{30} & \qquad \tfrac{3}{5} \text{ ton} = \frac{3 \times 20}{5} \text{ cwt.} = 12 \text{ cwt.}
\end{array}$$

Answer:—2,880 cubic feet, or 57 tons 12 cwt.

Cost of making a Silo.

The cost of making a permanent silo varies, of course, very considerably with the nature of the soil to be excavated if a sunken silo is built, also with the price of the material employed, the degree of stability of the structure, the natural facilities of the ground, and the price of labour; but, perhaps, the most important factor in the calculations is the size of the silo, and, as a rule, it may be said that, other things being equal, the larger the cubic contents of a silo the cheaper will its cost be per unit of measurement. Thus, it stands to reason that the cost per cubic foot will be considerably less in a 10,000 feet silo than in one of 1,000 cubic feet.

In some specially-constructed silos the cost has reached as high as £2 10s. per ton (50 cubic feet), while the cost of more modest, but just as efficient, constructions has in many instances been kept as low as 5s. to 7s. per ton, and in the case of earthen pits, 50 cubic feet can be excavated for from 1s. to 2s.

In this connection Mr. W. L. Boyce, of Lochinvar, Hunter River district, recently wrote (*Agricultural Gazette*, May, 1898): "I have always recognised the fact that a pit is superior to a stack, but the great expense that I have always read about, and the trouble of applying pressure, has prevented me from going in for one before; but I have now constructed what I believe to be the cheapest permanent silo on record, and I think this paper would not be complete without giving you the benefit of my knowledge. The pit is circular, 15 feet diameter, and 17 feet 6 inches deep; 18 inches of the wall is of concrete, the next 6 feet, three coats of cement, and from there to the bottom two coats, and the bottom itself one coat. The excavated material was lifted by a horse working in a circle, the skips being swung round by the gaff and tipped where required for a roadway. The pit so far was completed by three men in fourteen days, 5½ casks of cement and 20 lb. of blasting powder being used. I have at leisure built the walls of the pit 3 feet 9 inches higher, and formed the roadway up to that level. I intend to build the walls yet higher so that the pit will be 25 feet deep and have a capacity of 100 tons."

Roofs over Silos.

Although a roof is not absolutely necessary, it is advantageous on the larger and permanent silos. The roof may be of any material, either bituminous paper, tarpaulin, boards, thatching, or galvanised iron. In many cases trusses of straw, or simply a thick layer of soil, answers the purpose of affording shelter as well as weight. Corrugated iron, although costly in the first instance, proves in the long run one of the most convenient and economical materials that can be used.

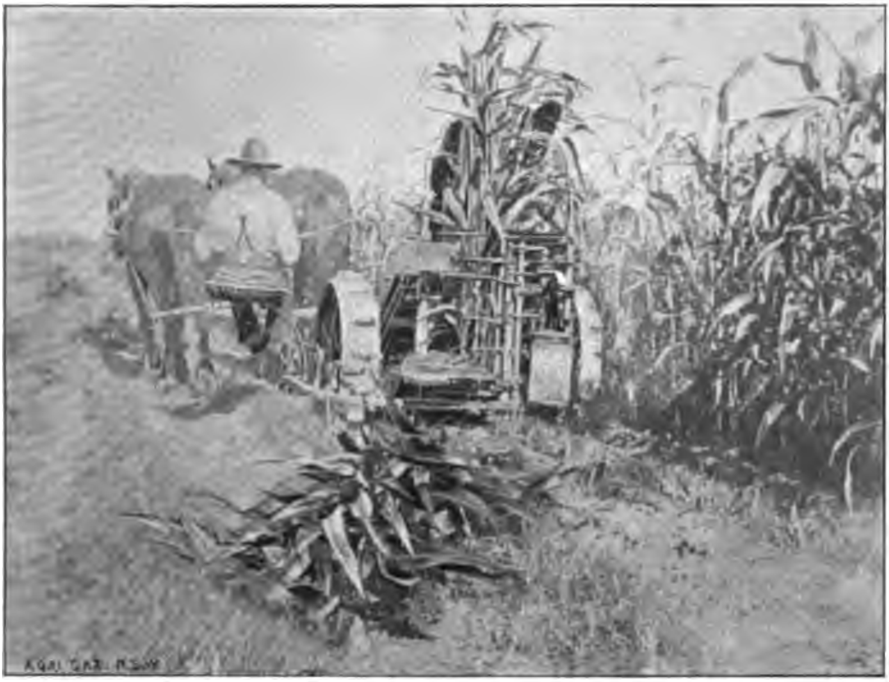
In one of the back numbers of the *Sydney Mail* will be found a description, with illustrations, of an Australian silo, of cheap construction, erected by Mr. W. Lamb, at Rooty Hill. It is placed under a hay-shed simply as a matter of convenience, so that the same roof answers the purpose of protecting the silage as well as the hay or other agricultural produce, which may be stacked on the top of it if necessary.

Tub Silos.

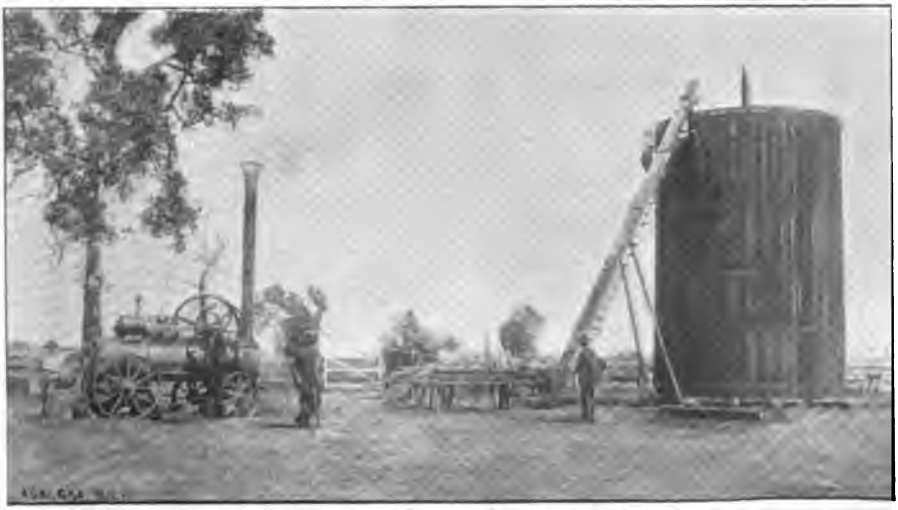
In Canada and other places where the preparation of silage is conducted on an extensive scale, a good deal of attention has during recent years been directed to the construction of circular wooden silos, which are claimed to be the cheapest and handiest receptacles for silage.

The Department has had one capable of holding about 100 tons of fodder built at the Hawkesbury Agricultural College, and the illustration shows how it is filled by means of an elevator attached to a machine which chaffs green maize at the rate of 15 tons per hour.

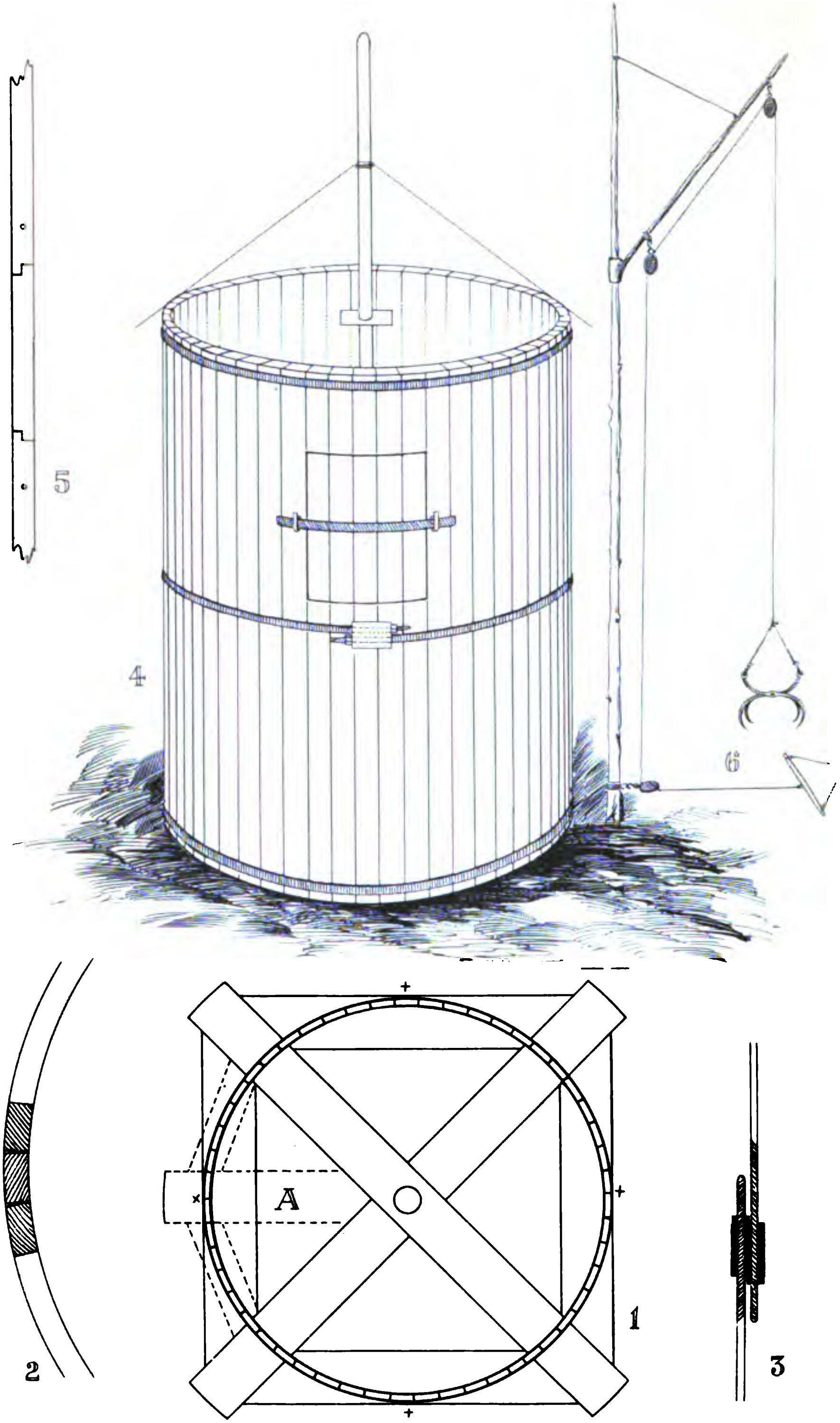
For the guidance of farmers who would like to try one of these silos on a small scale, Mr. Carpenter Brooks, of the Hawkesbury Agricultural College, has supplied the following plans and specifications of a wooden tub 10 feet high, 8 feet in diameter, and holding about 10 tons of chaffed silage.



HARVESTING MAIZE FOR ENSILAGE.



FILLING THE TUB SILO AT HAWKESBURY AGRICULTURAL COLLEGE FARM.



A CIRCULAR WOODEN SILO.

1. Floor plan. 2. Showing how planks come in contact. 3. Screw joint of iron bands or hoops. 4. The Silo. 5. Showing how door is let in air-tight 6. Derrick and hooks for filling with uncut greenstuff.

This is, of course, a small silo, and costs more in proportion to its size than a larger one.

For instance, the cost of material amounts to from £6 to £7, and labour about £5, whereas Mr. Carpenter Brooks estimates that a silo to hold 100 tons would only cost £35 for materials and construction :—

Foundation.—Fig. 1—Take two logs about 12 inches through and about 12 feet long, and halve them together at right angles to each other. Then fit four more logs on stout slabs, between the points of the logs, and face the whole to a flat surface, to provide a level seat for the silo. The different parts should then be spiked together. At the points marked X the outer edges should be cut out to allow two of the planks to pass down to be spiked down to the foundation, and thus secure the silo. Or additional short slabs could be secured on the outer face of the silo and to the foundation, thus avoiding the necessity of getting any of the planks extra length. NOTE.—At the dotted lines marked "A" an extra cross log is shown which would be required for larger silos.

Walls.—The silo is then formed of 6-in. x 2½-in. planks, sawn straight and square (not bevelled; see fig. 2) on the edges to joint together, and brought together by ⅝-inch round iron bands, screwed about 12 inches at each end, and both ends passed through a hardwood block, bored end grain to the nuts (an iron box would, of course, be better), and tightened by nuts and washers. This is a point that requires careful attention when the silo is first filled. See that the bands are not too tight, and loosen them a little occasionally the first two or three days, as the timber will swell out. Also, in larger silos, the bands require to be in two lengths, and if they are not looked after the first day or two, they are very apt to give way, when, of course, the result can be better imagined than described. Three bands would be sufficient for this silo, the bottom and top ones being about 12 inches from the ends.

Doors.—As many openings as may be required is made by cutting the planks with rebated end-joints (see fig. 5), so that the door-pieces are put in position from the inside when filling the silo. The planks above and below the doors should be doweled as shown by fig. 5.

Roof.—The covering is formed of canvas, after the style of a military bell tent, the bottom being secured to the top iron band, through holes which can be punched at 2-feet intervals; ¼-inch holes would be quite large enough, wire being used to tie down with. The centre post is provided with a block at the foot to prevent its sinking into the silage; and it is as well to have a flap in the covering to enable a man to get in and place another block under the pole if necessary, after the silage has commenced to settle.

Inside lining.—It is advisable to cover the inside face of the walls with tar paper as the filling proceeds, both to keep the air out and to prevent any particles getting jambed into any joint that may be sufficiently open, which will be all closed up quite tight in twenty-hours after the silo is filled.

Materials and cost.—The following material is required to construct a silo as herein described :—

	£	s.	d.
52 pieces of 6-in. x 2½-in. selected Oregon,* 10 feet long ...	3	5	0
4 logs 12 ft. x 12 in., diameter	1	10	0
4 slabs 7 ft. x 12 in. wide	0	10	0
3 ⅝-in. round iron bands, 28 feet long...	1	2	
Total	£6	7	0

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* Any other timber that is available may be used.

SILAGE STACKS.

Silage stacks are decidedly the most desirable for the requirements of Australian stock-owners, as their cost amounts to very little. They may be erected whenever and wherever found convenient, and as a means of preserving green fodder they are just as efficient as the best-constructed pit silos, if proper attention has been paid to the stacking and packing of the material used.

Silage, by reason of its being almost as succulent as green fodder, is not susceptible of being destroyed by fire, and on a great many of the stations and runs situated in the drier districts of this country the anxiety of the stock-owners would be greatly relieved on that score if instead of the dry hay-stacks, which are a source of constant danger, the fodder were stored as silage in either stacks or pits, and fed off by stock under that form in seasons when succulent food would be particularly acceptable and beneficial to them.

The method of applying pressure having been decided upon, the most convenient site is chosen for erecting the stack, and as level a base as possible should be prepared, to prevent the stack from heeling over under pressure, which is one of the difficulties to be guarded against. Should a stack show any tendency to lean on one side, props should be set against the leaning side. It is advisable to raise the level slightly above the general surface of the ground, so as to allow for drainage during construction. A ditch opened round the stack will collect and carry away the surface water.

According to the amount of green fodder to be turned into silage, it is expedient to build one or more stacks. Generally speaking, the amount of waste will decrease proportionately with the size of the stacks, inasmuch as the larger the stack the less the exposed surface.

For a small stack silo of about 20 tons, the base should be about 10 ft. x 10 ft.; for 40 tons, 12 ft. x 12 ft.; for 80 tons, 14 ft. x 14. ft.; and for 100 tons, 16 ft. x 14 ft.

The crop should be put on the stack with as little delay as possible, and not allowed to wither on the ground, the work being pushed on regardless of weather.

An elevator is of considerable assistance for raising the green stuff, either direct from the cart or from the chaff-cutter, in the operation of building a silage stack. Where an elevator is not available, the fodder may be forked from the cart to a platform of boards, erected about 12 feet from the ground, and from thence on to the stack, which by this means can be raised to about 22 feet high at the eaves before settling, and will stand after settling, and according to the nature of the green stuff, from 10 to 14 feet high.

Although it is claimed that by means of several of the systems described further on a pressure of 200 lb. and more per square foot can be applied by one man, experience has demonstrated that if the stack has been carefully packed and built, and especially if the green fodder is succulent and somewhat wet, a much lighter weight will give equally good results. As will be explained in the course of these notes, exclusion of air and temperature regulates the successful preservation of the fodder and the production of either the so-called "sweet" or of "sour" silage. A pressure of 1 cwt. per square foot surface is usually sufficient in the making of sweet ensilage, or ensilage possessing the fragrant smell of fruit, and a pressure of 1½ to 2 cwt. in the case of sour silage. It is evident, however, that the amount of pressure cannot be the same in every case, and that the coarser maize, sorghum, or sugar-cane tops, will require a heavier weight than the more tender meadow-grass or lucerne.

In the same stack, moreover, "sour" silage is often found at the bottom, where the pressure derived through the mechanical appliances is increased by the amount of weight of the mass above, whereas, at the top, where the weight is not so great, and, as will be explained in its proper place, the air has not been so thoroughly excluded, the result is found to be "sweet" silage.

Methods of Pressure

Are of two kinds: *dead-weight*, such as bricks, stone, blocks of concrete earth, iron; or *mechanical appliances*, which, owing to the fact that dead-weight is more or less cumbersome, and entails greater loss of time and energy in hoisting, moving, and displacing, has lately come prominently to the front.

Mechanical presses may be either self-acting, and afford continuous pressure, or else have to be intermittently tightened. Screws, levers, chains, and other contrivances have been designed for the purpose of securing the required pressure. A few of the most typical of these appliances are figured and described here.

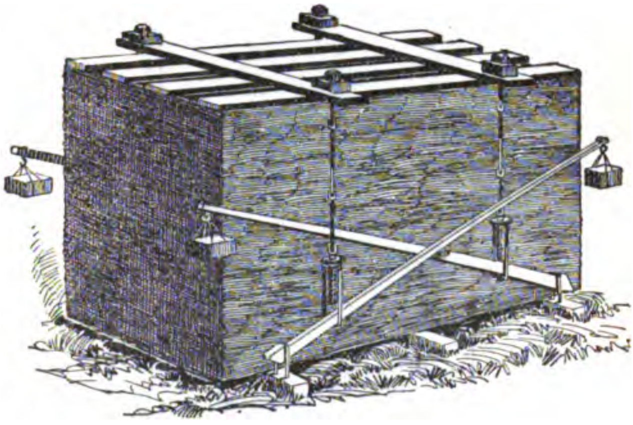

Fig. 6.—Blunt's Patent Press.

Mr. Thompson, then Principal, Hawkesbury Agricultural College, in 1892, during February, built about 8 tons of green maize (broad-cast sown) into a small stack, applying weight by using some spare posts and rails. When opened in July, it was found to be in a perfect state of preservation, the cows eating it with avidity, improving very considerably in their milk supply.

Blunt's Patent, or some simple modification of the system, is certainly one of the best contrivances for pressing ensilage stacks. It combines the two principles of the screw and lever, is not costly, is easily rigged up, and one main advantage is that by its means "continuous pressure" is secured. It somewhat resembles the old-fashioned cheese press arrangement. This system is also applicable to circular stacks.

This department has received from Mr. Mahlsburg, of the Richmond River Sugar Company's mill, Rous, a description accompanied by a diagram, of a modification of the Blunt system of continuous pressure, which has been published in the *Town and Country Journal*, and in the *Agricultural Gazette* and is now reproduced.

Description of Lucerne Stack Ensilage as tried on the Richmond River Sugar Co.'s Farm in Rous, Autumn, 1891.

The Stack.—On the four corners of a square measuring 10 ft. x 10 ft., and pegged out in a dry position, besides being protected by small drains (D) against the rain-water flow, were erected about 3½ ft. deep in the ground four saplings (A), about 28 ft. high and of a diameter 10 in.–15 in. On the three sleepers ($B_1B_2B_3$) was then laid the flooring (F) of strong but rough timber-slabs, and the lucerne, after it was stacked, was covered with slabs ($S_1S_2S_3S\ldots$). The light roof (C) of corrugated iron sheets should be so constructed that it can be easily lowered or raised and fixed (as shown) by pegs ($p_1p_2\ldots$) according to the height, at any time, of the ensilage in the stack, which diminishes gradually under the constant pressure to which it is subjected by the following simple mechanism.

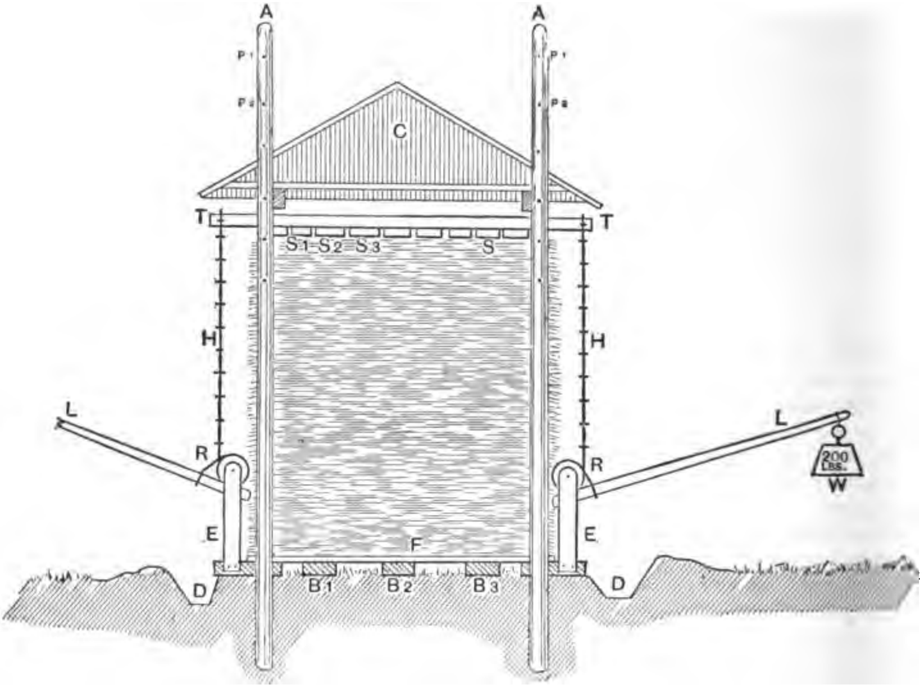

Fig. 7.

The Press.—On each of the opposite sides of the stack is fixed to the wooden supporters (E), on iron axles, a wooden roller (R) of about 1 inch in diameter, and on the top slabs (S_1S_2) are laid across, and just in the middle of the same, a strong timber-piece (T), to both projecting ends of which are attached the chains (H). These chains are then twisted round the roller and strained by means of the latter as tightly as possible, while the levers (L), inserted with one end into the chains and under the rollers, support heavy weights (W) on the other end, and act continually in the same direction, viz., straining the chains by revolving the rollers till their far ends (with weights on) come down to the ground, when they are raised, the loosened chains adjusted, and again put in proper position for automatic action.

Johnson's Ensilage Press.

To Mr. C. G. Johnson belongs the credit of having popularised and advocated for many years the making of silage in stacks.

The latest improvement of the "Johnson" press, and also the simplest and the most durable, is what is called the "ratchet drum" press.

"The apparatus consists of two or more pairs of drums, each drum being provided with two rows of rack teeth, being exactly opposite to each other, on either side of the stack, bolted to the frame; of single wire ropes, attached to both of each pair of drums, and passing over the top of the stack; and of a lever fitted with two pawls for engaging with the rack teeth on the drums for the purpose of tightening the ropes, each set of teeth being also provided with pawls, so that the drum is held in the position which it has reached until the next stroke of the lever and pawl brings it round to another tooth.

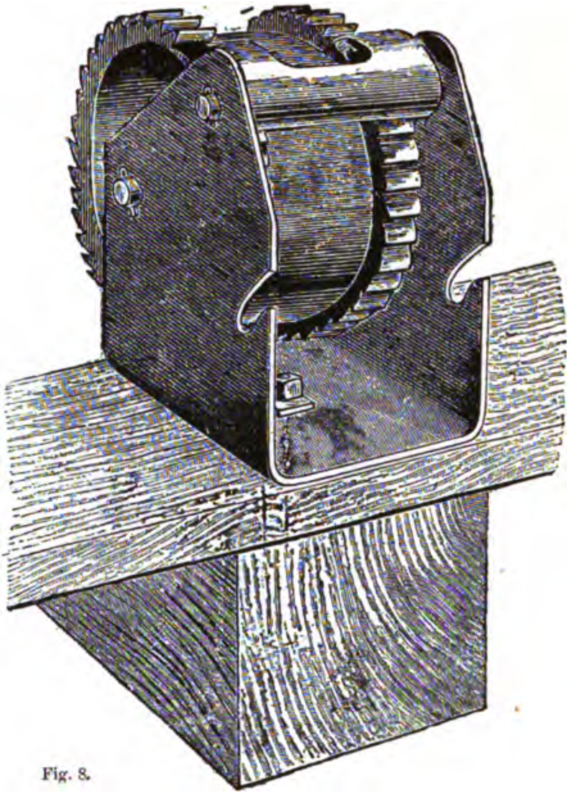

Fig. 8.

"The framing above referred to consists of as many timbers as there are pairs of drums, let into the ground, so that the upper sides are flush or level with the surface, 3 feet apart, centre to centre, and long enough to project 2 feet beyond each side of the stack. At each end of the timbers, and on the top of them, a plank 12 inches broad by 3 inches thick is laid, and on the top of this plank the drums are placed. A bolt passes through the timber, the plank, and the bottoms of the frame of each drum, and is fastened on the top with a nut. The timbers are then let into the ground, so that the bottom of the plank rests on the ground. Across the timbers, and close to the sides of the stack, some rough pieces of wood should be laid, to prevent the logs from pulling up into the stack, and the spaces between these rough pieces should be well filled in and made solid with earth, so as to leave a level bottom, as any air spaces cause mould, and should be avoided."

This done, the base is ready to receive the fodder, which is heaped up perpendicularly, the wire ropes are fastened to the drums, passed over the stack, and pressure is applied, the pressure being exercised at the side as well as at the top, leaving the latter rounded. The stack is then thatched over the wire rope, and has the appearance of an ordinary hayrick.

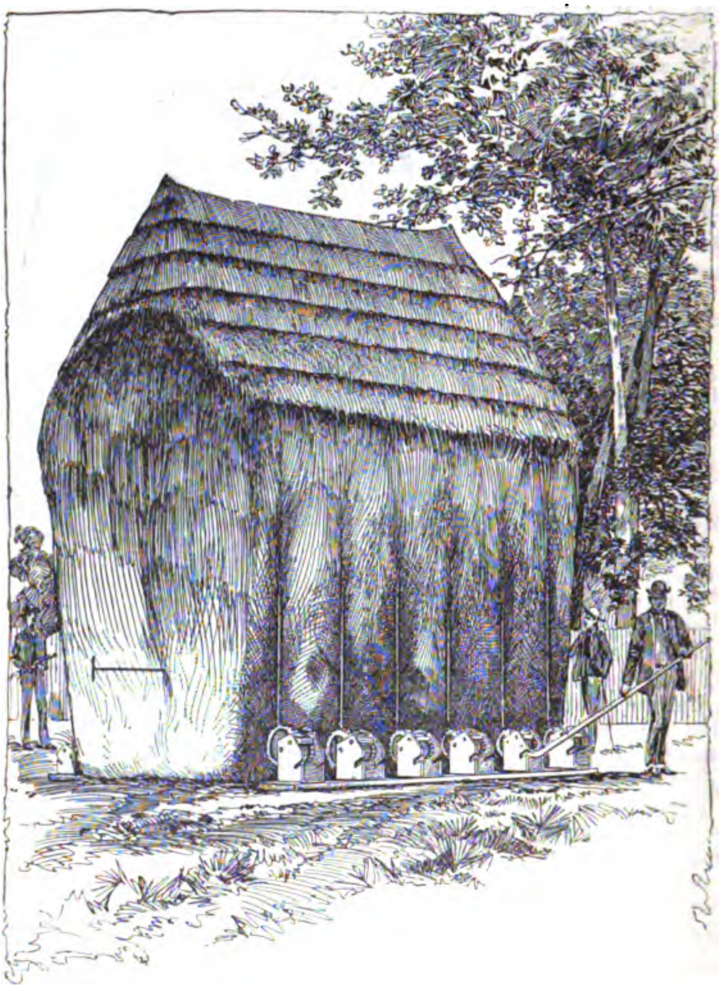

Fig. 9.

Mr. Throsby's Silage Stack.

One of the most economical methods of ensilage that has come under the notice of the department is that devised by Mr. Herbert Throsby, of Moss Vale. Mr. Throsby has devoted many years to the study of fodders for dairy cattle, and his system has much to commend it to the serious attention of anyone desirous of providing winter feed.

To begin with, all the wood required is rough timber, which can be procured on most farms by the aid of an axe. The only portions of the plant requiring to be purchased are three blocks, a pair of iron "grippers" or jaws, some wire rope, and some ordinary hempen rope. The method of raising the fodder is also worthy of careful note. To the left of the lower view of the plate will be seen a rough mast, to which is fitted a spar with jaw attachment working on the mast. At the base of the mast is a winch, to which the jaws are attached by means of a rope for raising the green fodder, and the movable spar allows of its being placed on the exact spot selected by the man on top, while the gripper quickly and effectively grasps or releases the bundles of fodder. By means of these arrangements a man at the winch, a man to stack, and a boy to work the jaws are the only assistants required.

The accompanying illustration shows the method of applying pressure, and the following is an account of the construction of a stack of 70 tons:—"Take seven logs 16 feet long x 9 or 10 inches diameter at smaller end. At 9 inches from each end saw in about 3 inches, and adze off the shoulder. Place these logs upon a level place near the bail, at 3 feet apart, centre to centre, adzed face down. Fill up to level of tops and make solid. Two strong pieces, rails or scantling, should be laid across the three end logs at each corner, 3 feet apart, to prevent the outside logs lifting when the pressure is put on. From a box, ironbark, or other tough sapling (say) 6 inches through, cut twelve rollers 3 feet long, adzing the ends down to circle marked by compass. Bore with 1¾ auger two holes through each end, the outside ones to clear bottom logs, when placed under ends, the others at right angles to the first, but clear of the first set of holes—an auger hole in each roller to carry end of wire rope to grip on roller. At one corner of stack erect a sapling (say) 20 feet out of the ground, to which connect a gaff 10 feet long, with iron jaw to fit round mast, as shown in sketch—so allowing the stuff to be hoisted on to stack from one end and one side if necessary.

"At foot of mast construct a winch as shown, fixing block below the drum, so as to have the strain downwards when hoisting. Obtain one iron jaw, on the principle of those used by contractors to lift heavy stones, with each arm divided below the connecting bolt into two teeth, a foot apart at the points. Affix a block at end and one at foot of gaff, and one below drum of windlass—run a strong rope through these blocks, connect with windlass, and fasten the lifting jaw on to the other end.

"For distributing the pressure evenly on the stuff after stacking, get six dead logs 16 feet long x 8 inches diameter, and bore 1-inch auger hole through each end about 15 feet apart; twelve wire-ropes (gal.) the height your stack will be, allowing for one turn round end of top log. The top logs are placed directly over the centre of the rollers between the foundation logs, and the tightening is by means of levers as shown on the plate. The pressure is secured by means of pieces (about 18 inches long) of gas-piping which pass through the rollers and catch in a small sapling which is fixed under the bottom logs. Now for a fair estimate of the cost of this seemingly complicated arrangement. It will cost about £2 13s. to get, dress logs, and erect mast and windlass, and cut rollers and bore them. Three single blocks, say, 15s.; jaw for mast and one for lifting, 15s.; rope (hemp), 10s.; wire ropes (1½ inch circumference), £2 10s.; two iron bars. 9 ft. x 1¼, £1 5s., making a total of £7 15s. for a plant that will last for, say, seven years, although the only portion requiring renewing at all will be the timber and hemp rope.

"The cost per ton of the silage is rather more difficult to get at, but, taking a fair crop of corn to cut 20 tons per acre, it will not cost more than 6s. 6d.

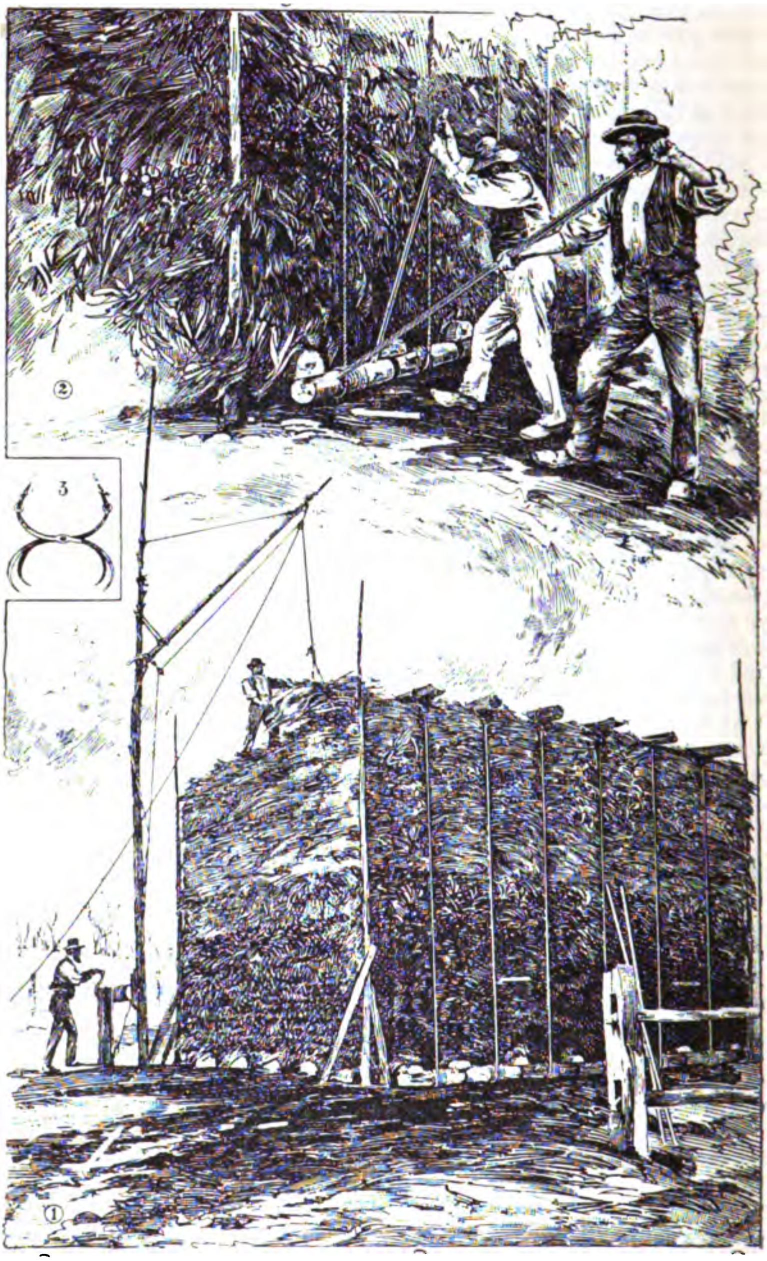

Fig. 10.
1, General view of stack; 2, process of increasing pressure; 3, the "Gripper" or "Jaws."

per ton when ready to feed the cows. Ploughing and harrowing 1 acre twice, say, 30s.; scarifying three times, 9s.; drilling and harrowing in, 4s.; seed (1 bushel), 5s.; cutting, 12s.; carting, 36s.; stacking, 30s. Total, 126s. Thus making the 20 tons cost £6 6s., or say, 6s. 6d. per ton. This estimate is a high one, for it allows three men for carting and loading two drays (tip), *i.e.*, two always loading and one driving—it allows for two men and a boy at the stack, and gives two days to put together 20 tons, which is less than could be done were the stuff grown close to the stack, for this estimate is based on work done with drawing nearly half a mile.

"The corn being cut with a cane-knife is all laid one way in heaps convenient to the cutter, allowing width enough between the rows of heaps for the carts to pass, the body of dray is filled with the butts of the stuff up to the front board. When level with the side rails the bundles are placed crosswise, tops and bottoms alternately, and, by thus loading, as much as 1½ tons can be put upon a small-sized dray. This is taken to the stack and tipped, and comes out as placed in without being tangled and twisted together. Each armful can be easily separated and the jaws of the iron lifter placed round it. When hoisted on the stack it is carefully placed, always keeping the outsides of the stack higher than the middle, because the latter is more solid from the treading than the former. When the stack has been raised to 8 or 10 feet, the logs should be placed on the top, and a constant pressure be given for, say, three days, to consolidate the mass and prevent the temperature from rising too much. A simple way of getting at the temperature is to lay a ¾-inch gas-pipe slightly inclined, reaching about half-way across the stack and built it in with the corn. By connecting a thermometer (graduated to read up to a temperature of, say, 200 degrees) to a piece of wire, it can be pushed down the pipe, the end of which is then corked up, and after a few seconds the thermometer may be taken out and read. With corn it will reach sometimes 150 degrees, but ordinarily about 110 degrees is the limit.

"An advantage gained by having the pressure square on the top is that when stacking is again commenced, you have a square foundation, and not rounded as when ropes over the top have been used.

"The sides and ends should be kept plumb and cut neatly with a hay-knife. It is a very good plan to put up permanent posts at the four corners, the mast being one.

"When the whole of the stuff is stacked, it is advisable to place a piece of scantling or sapling along the edge at each end, and short pieces from underneath the first and last top logs on to it, thus securing an even pressure along those edges. The end logs do not press as close to the outside as is necessary; in fact, some trouble taken to place pieces with their ends under each log at intervals would be well repaid by distributing the pressure evenly over the whole surface, and they can be taken out as each section nearly up to a top log is cut out for feeding.

"The covering can be done as approved by the owner, but sheets of roofing iron forming a simple slanting roof with a fall of about a foot, will answer the purpose, and the sheets of iron can be removed as required."

It is satisfactory to be able to add that the method described has been tried by several farmers, who are all much pleased with the result. There is not more than 3 inches of waste on top, and about 6 inches on the sides. The silage is in excellent, juicy condition, and much relished by the cows.

Mr. H. Elkington, Burrier, on Economical Stack Ensilage:—"The recent drought, and consequent losses entailed upon stock-owners from shortness of feed, should direct the attention of all such to the question of cheap conservation of fodder. The ordinary resources for feeding stock on hay, green oats or barley, lucerne and bran, though no doubt of great value, are open to serious objections. Hay is expensive to make in quantity, is liable to be spoilt by rain whilst making, and the risk from fire is very considerable. Recent experiences prove this. Bran is very expensive, and modern low prices do not justify the outlay. Green-stuff of various kinds is the most usual, but is open to the objection that in times of drought growth is slow; in wet weather it is not good feed, and it is expensive to cut and cart out to stock, besides which it is not such good milk-producing food as one that contains even a modicum of grain. It poaches the land to go on it with drays after rain, and stock, if turned into it for a short time daily, which is a common practice, spoil as much as they eat. As the relative advantages of ensilage have been so long before the public, it is probably unnecessary to say more as to the value of the system, and I will proceed to describe my attempt. Firstly, I may say I got my idea from 'Practical Dairying in Australia,' in which work a stack silo made by Mr. Throsby, of Moss Vale, is described and illustrated. I slightly modified this, with the result that I built a stack containing over 15 tons of forage for a cash expenditure of 15s., being cost of blacksmith work for gripper and windlass handle. I commenced by levelling site of stack (say 12 feet by 10 feet). At each corner I erected a sapling. Then I got some stout logs, cut a shoulder at each end (say 6 inches in from the end); placed them across the floor, under each end placed a small sapling for ends of pegs to work against; placed logs about 2 ft. 7 in. apart, centre to centre, of course having one at each end of stack. Then got some tough wood and made rollers to work under shoulders of logs, and bored three holes in each roller at different angles for crowbar to work in as lever. On top, when the stack was finished, I laid some sticks lengthwise of stack to equalise pressure, then logs crosswise corresponding to the bottom ones. Then I took some strong wire, fastened it to the rollers and top beams, and wound up as tightly as I could, fixing pressure by strong pegs through holes in the rollers. I used No. 8 steel wires, but twisted galvanised wire would, I think, be better. To save trouble in fixing the wire daily on to the top logs, I think it would be a good plan to put a wire loop on the top logs, and one at the end of the wire, and connect by an S hook. This would save time of fastening and unfastening every time you wanted to add to the stack. I roofed the stack, when finished, with bark, pitching an ordinary gable roof over it. I used a couple of forks at either end of the stack to support the ridge-piece, and lashed the wall-plates to the four corner saplings; then put on rafters and battens in the usual way for a shed roof. I omitted to say that the bottom logs should be filled in tight with earth, so as to make a level floor. The stuff I used was Planter's Friend, which I cut when the seed was just doughy, and while the flag was still green. I cut it with a short scythe, bundled it up into armfuls, and drew it to the stack on the slide, arranging it in cross-layers in the stack. When the stack got up a bit, I used a hoisting contrivance—a mast erected at one corner of stack, with windlass at foot. On the mast I slung a gaff by a sling such as fishing boats have. The rope used for bailing up heifers made peak halyards. At the end of the gaff and at the jaw I fixed a block and a snatch-block at the foot of the mast; ran a plough-line from snatch-block to windlass, and so through the blocks to gripper. This gripper is an adaptation of the one used by quarrymen for lifting blocks of stone, and may be described as two S-shaped pieces of iron crossed and pivoted in the centre, so arranged that by pulling on the top ends the lower arms grip the load. The stuff requires to be stacked as quickly as possible, built evenly, and pressure put on every night, following the stack down as it sinks. The edges should be cut down square with a hay-knife well clear of rollers and wires. A cubic foot of silage weighs about 45 lb., so this will be a basis of calculation. The stuff is ready for use in from six weeks to two months' time from finishing off. It will sink down rapidly under pressure. The whole principle is to stop fermentation by excluding air by pressure. If the temperature rises over 140 degrees it spoils the feed. I placed a gas-pipe in the stack, and ran a thermometer through with a wire. To stop heat, press tighter; keep the temperature down all you can from the start. The stuff will keep good two or three years if required. When I cut my stack open I found some of the outside stuff bad. This is to be minimised by care in applying pressure to the edges. I found that my cattle did not take kindly to it at first, not being used to it. In fact, I thought it was no good. To test the matter I sent a truss to the Agricultural College, Richmond, for report, and was advised that it was first-class stuff, and that their cows ate it readily, no doubt being used to it. On this I threw my stack open, with the result that my own cattle camp alongside of it, and have almost eaten it all up, showing that it is a taste that has to be acquired. Salt scattered through the stack might help this. The total cost to me was two men's work, one week fixing the stack, and three men a week filling stack, and 15s. for blacksmithing; timber being had for the labour of cutting it, and the stack timbers do again another season. The stuff in appearance had a colour slightly brownish, inclining to black near the outsides, and had a sweet pungent smell like moist tobacco, and was quite warm when cut out. Care must be taken to feed after milking and away from the yards, or it may taint the milk."

Several other dairy farmers have tried this method of ensilage, and all agree that the stuff so prepared is first rate.

Physical and Chemical Changes.

* "It would be an erroneous idea to fancy that silage is such a marvellous thing that it actually acquires, during the slow and gradual process of fermentation to which it is subjected, more nutritious substances than the green-stuff itself contained previous to being subjected to this method of preservation. By the process of ensilage the green fodder is subjected to important physical as well as chemical changes. The physical changes modify—1st. The colour, which turns darker; 2nd. The taste, which becomes more palatable; 3rd. The smell, which changes to a more penetrating one, without, however, being in the least objectionable to stock; and 4th. The volume and degree of toughness of the green-stuff, which decreases considerably after packing closely, withers, and becomes more tender, and less fibrous. Well-preserved maize, sorghum, and rye, however, should keep a green tint, and not turn dark.

"The modifications, therefore, which accompany the process of ensilage may be pronounced to be such as are favourable for its disposal as food for stock.

"As soon as the grass is cut it begins to undergo certain changes. Of course, it loses water; but if it is gathered quickly and put into the silo at once the loss is not very great. When the grass is put into the silo the first chemical change that takes place is that a large quantity of carbonic acid gas is given off, just as in the case when a vat is filled with grapes; at the same time the stuff begins to heat, owing to the process of oxidation going on in some of the materials which constitute the tissues of the grass. That process of oxidation is due to the presence of active agents of fermentation. These little microbes live and multiply best at temperatures which differ very much.

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* J. A. Despeissis, M.R.A.C., *Agricultural Gazette*, Vol. II.

Sour and Sweet Silage.

"If the temperature in the silo is not allowed to rise too high, and that can be controlled by ramming it down and weighing it, then the other changes which go on afterwards, principally result in the formation of various acids, chiefly acetic acid (the acid in vinegar), lactic acid (the acid of sour milk), and butyric acid (the acid which is present in rancid butter, and sometimes in cheese, and to which the disagreeable odour of many samples of silage is due). In that case ***sour*** silage is produced through the agency of the various microbes of acetic, lactic, and butyric fermentation. The temperatures most congenial to these animalcula range from 33° (91° F.) to 38° C. (100° F.) for the first (about the temperature of blood heat); 38° C. (100° F.) to 48° C. (118° F.) for the second; and about the same temperature of the third agent of acid fermentation. It has been found that whenever this range of temperature is not surpassed in the silo ***sour*** silage is the result.

"On the other hand, if the temperature during the fermentation is allowed to rise higher, viz., 55° C. (130° F.) to 65° C. (150° F.), 'sweet' silage, which possesses a fruity fragrance, is generally produced. The term 'sweet' is only used in a figurative sense, and does not infer the production of sugary matter or of alcohol, and it simply means that it does not undergo acid fermentations. In fact, the yeast of alcoholic fermentation is destroyed at a temperature considerably lower than that which is noticeable in the course of the making of 'sweet' silage, and the same may be said of the agents of acid fermentations just mentioned, which do not survive a continuous temperature of 55° C. (130° F.), or over.

"In those stacks or silos where the temperature varies between 110° and 150° F. we have a mixture of part sour and part sweet silage. If the temperature rises above 150° or 160° F. part of the fodder will undergo a more complete oxidation, or, what comes to the same thing, a greater state of combustion, and instead of turning to a light shade of greenish brown, will turn black brown, of course much to the detriment of the nutritious value of the fodder.

"As a rule, therefore, in making 'sweet' silage, the crop should not be heaped up so quickly, so that, under the influence of a greater access of air, the oxidation processes take place to a larger extent, and a higher temperature is developed.

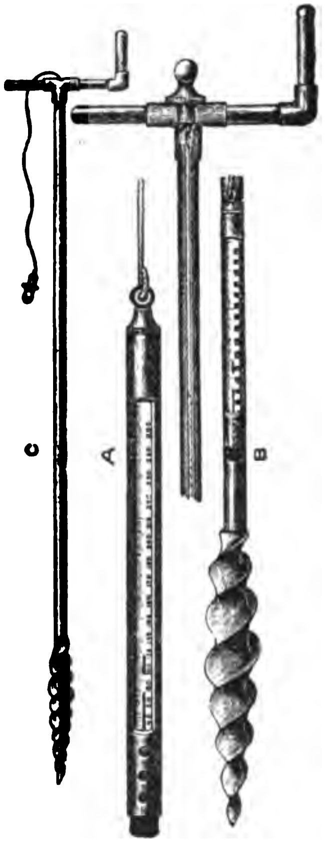

Fig. 11.

"The temperature can easily be controlled by means of the stack thermometer shown in Fig. 11; if the thermometer, for instance, goes too high, additional pressure put on the silo will lead to a more complete exclusion of air, and a consequent decrease in the intensity of the fermentation indicated by a lowering of the temperature. If, on the other hand, the making of sweet ensilage is aimed at by regulating the weight and the entrance of the atmospheric air, a higher degree of heat is generated in the mass of the silo.

"It should be remembered that the whole question of silage-making may be summed up in the word 'temperature,' which is regulated by the more or less complete exclusion of air. During the process of turning green fodder into silage the temperature registered on a temperature-sheet describes a curve or semi-circle. Starting at the temperature at which the green-stuff is placed into the silo, it rapidly rises till it reaches its highest degree, after which it gradually decreases, and after a long lapse of time, falls down to the normal temperature again.

"The question may then be asked, why 'sweet' silage, for instance, does not turn into 'sour' silage, after the heat has subsided to 33° C. (90° F.), or below? The answer is simply because the high temperature at which sweet ensilage is made is far above the degree of heat sufficient for killing the germs of acid fermentations in the mass of the silo. Also, the high temperature evolved has caused the mass to settle and pack closely, causing the exclusion of air which is absolutely necessary to the growth and multiplication of the germs of acid fermentation, and although some air can get entrance into the silo, after it has cooled down, these germs cannot themselves penetrate more than a few inches from the surface, the air which carries them depositing them on the outward layer of the silo, as it filters through the compressed fodder."

ENSILAGE AT THE WAGGA WAGGA EXPERIMENT FARM.

In March, 1896, an ensilage stack was constructed at the Wagga Wagga Experiment Farm on lines very similar to those of the stack described on page 108, except that the following alterations were made:—The posts were placed 10 ft. x 15 ft. instead of 10 ft. x 10 ft. The chains were carried round the roller on the opposite side to that shown in the diagram and attached by means of a strong hook to the end of the lever, thus obtaining a much greater leverage.

This shed is capable of holding from 50 to 60 tons of ensilage, and will last for many years. The cost was as follows:—

	£	s.	d.
Four poles, 30 feet long x 12 inches diameter, 12s.	2	8	0
Roof—seventeen sheets galvanized iron, 8 feet	2	12	6
Timber for flooring, roof, and press	3	15	0
Chains, wire-rope, iron fittings, &c.	3	10	0
	£12	5	6

First-class timber was used, and therefore the shed was more expensive than if bush timber had been used. Bark-roofing would also do in place of iron.

Filling commenced early in April, about 10 tons maize stalks, cut in the field after the cobs had been pulled, being put in first. On this was placed a quantity of sorghum, millet, and pigeon-pea; the whole amounting to about 45 tons.

Two pieces of piping were put in the stack, so that thermometers could be inserted. The week after filling was completed, the temperature had risen to 130° Fahr., and from this it rose steadily, until in six weeks it stood at 168°. After this it went slowly down, and reached the normal temperature about four months after the stack was completed. It was then opened and it was found that the portion put in very green was in splendid condition, but that that put in ripe, such as maize-stalks, &c., had a great deal of waste. The ensilage was fed to dairy cattle, &c., and proved to be of excellent quality.

HAY-MAKING.

Lucerne Hay.

THE great secret of making lucerne, or indeed any hay, lies in the saving. The crop can be mown just when on the bloom. After mowing, the crop may lie on the ground from one day in hot dry weather to a couple of days or longer in cool weather. A little experience and observation will soon enable the haymaker to determine the exact length of time. It is then raked up carefully and cocked for a day or so, according to the weather; after which the hay is carted to the shed or stack. The greatest care should be taken in handling not to shake off the leaf. Upon the "leafiness" of lucerne depends its market value. It is advisable to leave the hay in the stack until all sweating has ceased. If baled for market before it has had time to sweat in the stack, the hay will heat after pressing, and open up mouldy, with the result that its selling value is much depreciated. Well saved lucerne hay always sells for from 5s. to 10s. and more per ton than the badly cured product. For pressing there are several machines in use, but for trussing and home use a little press on the lever or screw-jack principle may be easily constructed by an ingenious man.

Mr. Geo. Bishop, one of the most experienced lucerne producers in the Hunter District, recently said:—"There are various opinions on which is the better or more profitable lucerne hay for farmers to make—dry green or brown. I think the latter, as it requires less time for making, consequently there is less risk of getting rain on it. Many buyers object to brown because so much of it is dusty. That is the fault in making it, or in allowing the lucerne to get too old. Another mistake often made is in letting it get too dry for making real brown, or carting too fresh for dry green. Good brown hay has many advantages over dry green. It will, if stored, keep soft in the bales a very long time; it is also very much better for chaffing, as it does not (like the dry green) grind almost to powder; much better for feeding milch cows, as it produces more milk; is much easier pressed, and when put on the Sydney market will sell at as high a price. This is my experience during the past twenty-five years. Many farmers very seldom try to make dry green. If asked why, they will tell you that it does not bring a higher price; therefore can see no reason why they should run the additional risk of leaving it in the field a day or two longer. Another objection to making dry green is—in very hot weather it gets very brittle, consequently much of the leaf is lost. Agents generally quote higher prices for prime green. The principal reason for this is—it is mostly made during the driest part of the year, when it is finer and of a better quality.

"Great care should be taken to avoid pressing when the hay is too fresh (especially the softer crops) as it will frequently go mouldy in the bale, or cake together like tobacco in a box, but will not smell half so sweet. To store the spring crop it should remain in the stack from eight to ten weeks before pressing; in fact, I maintain that no heated hay is fit for storing much under that time. The only two crops which may with safety be pressed a little under are the December and January."

Oaten and Wheaten Hay.

When cutting oats, wheat, &c., for hay, it is advisable to consider whether the hay is likely to be used for local consumption or sent to the Sydney market. In hot, dry districts, where maize cannot generally be grown, consumers often feed their horses entirely on chaff, and therefore they select samples in which the grain is fairly ripe. For this market it is, therefore, wise to allow the hay to ripen well before cutting; but where maize is plentiful, such as is often the case on the Sydney market, chaff made from hay which has been cut when fairly green generally tops the market.

For sowing and cultivation, see farm section.

The reaper and binder has come into almost general use for cutting hay in this Colony. By cutting the sheaves small the hay will dry more quickly than in large sheaves. This is most desirable, as the sooner the hay can be carted in the less risk there is from damage by rain, &c. When the hay is cut very green care should be taken that the sheaves are not tied too tightly.

Stacking.

It is a good plan to make a sort of floor for the haystack. Logs or dunnage of any description will do for the purpose. If, however, it is more convenient to stack on the ground, a thick layer of straw should be strewn for a bed, and a good drain ploughed or dug around the site. The main thing in building a stack is to keep the sides well trimmed, and the body as nearly perpendicular as possible, otherwise the rick may heel over. The hay should be evenly and firmly tramped down as you go along.

There are several styles of haystack, but the safest one for the novice is a square or oblong stack, finished off like the roof of a house. Where good roofing-bark is procurable, or galvanized iron can be afforded, a permanent covering can be made. Most farmers, however, have to thatch their stacks.

Thatching the Stack.

Choose long, straight, sound straw. Place this in a heap and damp it, Then draw out the straw in bundles sufficient to cover 2 feet wide by 3 inches deep. Procure a number of wooden pegs about 2 feet long and about a little thicker than your finger. Thrust a peg in the stack through the bundle of thatch about 3 inches from the end of the 2 feet and about one-third of the length from the top. Then press the next layer close up, and so continue. In commencing put a peg in at the end of the stack to start your string from, and a similar peg at the other end of the stack to finish off. When building the stack be careful to finish off the top to a ridge or point, so that the thatch will meet at the top. In putting on the second and following layers the string of the previous layer should just be covered.

STORING POTATOES AND OTHER ROOTS.

BY far the best system is to pit them. This is done in the following manner:—Dig out a trench about 3 feet wide by 1 foot deep, and then cut a small drain down the centre—say, 6 inches wide by 3 inches deep. It is advisable to place the pit on land having a slight slope, as it can then easily be drained. Place a layer of straw in the bottom of the pit, then pile up the roots carefully until they are 3 or 4 feet above the ground, forming them into the shape of an arch. On the roots place a thick layer of straw, so that it covers them up entirely. Then pack the earth taken out of the trench on the top of the straw, and pat it down so that the rain will run off. If pits are made long and narrow the roots can be taken out at the ends in small lots without injury to the bulk by exposure to the air. Potatoes, turnips, beets, and other roots can be kept in good condition in this manner for months.

Average Composition of some common Feeding Stuffs.

[Taken from tables published by Messrs. JENKINS and WINTON, from analyses of American Feeding Stuffs.]

——	Water.	Ash.	Albuminoids.	Fibre.	Carbohydrates.	Fat.
GREEN FODDER.						
Cereal grasses—						
Maize-fodder (all varieties)	79·3	1·2	1·8	5·0	12·2	0·5
Sorghum (whole plant)	79·4	1·1	1·3	6·1	11·6	0·5
Rye-fodder	76·6	1·8	2·6	11·6	6·8	0·6
Oat-fodder	62·2	2·5	3·4	11·2	19·3	1·4
Other grasses (in bloom).—						
Red-top (*Agrostis vulgaris*)	64·8	2·3	3·3	9·4	19·1	1·2
Tall oat-grass (*Arrhenatherum avenaceum*) ...	69·5	2·0	2·4	9·4	15·8	0·9
Orchard-grass (*Dactylis glomerata*)	73·0	2·0	2·6	8·2	13·3	0·9
Weedon Fescue (*Festuca pratensis*)	69·9	1·8	2·4	10·8	14·3	0·8
Timothy (*Phleum pratense*)	61·6	2·1	3·1	11·8	20·2	1·2
Kentucky blue grass (*Poa pratensis*)	65·1	2·8	4·1	9·1	17·6	1·3
Legumes—						
Red clover (*Trifolium pratense*)	70·8	2·1	4·4	8·1	13·5	1·1
Alsike clover (*Trifolium hybridum*)	74·8	2·0	3·9	7·4	11·0	0·9
Lucerne (*Medicago sativa*)	71·8	2·7	4·8	7·4	12·3	1·0
Cow pea (*Dolichos*)	83·6	1·7	2·4	4·8	7·1	0·4
Soja bean (*Soja hispida*)	74·8	2·4	3·0	7·3	11·5	1·0
DRY FODDER.						
Maize-fodder (field-cured)	42·2	2·7	4·5	14·3	34·7	1·6
Hay from grasses—						
Couch-grass (*Agropyrum repens*)...	14·3	6·0	8·8	24·8	43·1	3·0
Red-top (*Agrostis vulgaris*)	8·9	5·2	7·9	28·6	47·4	1·9
Orchard-grass (*Dactylis glomerata*)	9·9	6·0	8·1	32·4	41·0	2·6
Timothy (*Phleum pratense*)	13·2	4·4	5·9	29·0	45·0	2·5
Creek-sedge (*Spartina stricta, var. glabra*) ...	8·3	10·7	6·6	26·9	45·4	2·1
Hay from legumes—						
Red clover (*Trifolium pratense*)	15·3	6·2	12·3	24·8	38·1	3·3
Red clover (*Trifolium medium*)	21·2	6·1	10·7	24·5	33·6	3·9
Alsike clover (*Trifolium hybridum*)	9·7	8·3	12·8	25·6	40·7	2·9
White clover (*Trifolium repens*)	9·7	8·3	15·7	24·1	39·3	2·9
Lucerne (*Medicago sativa*)	8·4	7·4	14·3	25·0	42·7	2·2
Cow pea (*Dolichos*)	10·7	7·5	16·6	20·1	42·2	2·9
Wheat straw	9·6	4·2	3·4	38·1	43·4	1·3
Oat straw	9·2	5·1	4·0	37·0	42·4	2·3
Buckwheat straw	9·9	5·5	5·2	43·0	35·1	1·3

AVERAGE COMPOSITION OF SOME COMMON FEEDING STUFFS—*continued.*

——	Water.	Ash	Albuminoids.	Fibre.	Carbohydrates.	Fat.
ROOTS, BULBS, TUBERS, AND OTHER VEGETABLES.						
Potatoes	78·9	1·0	2·1	0·6	17·3	0·1
Sweet potatoes	71·1	1·0	1·5	1·3	24·7	0·4
Red beets	88·5	1·0	1·5	0·9	8·0	0·1
Sugar beets	86·5	0·9	1·8	0·9	9·8	0·1
Mangel wurzels	90·9	1·1	1·4	0·9	5·5	0·2
Turnips	90·5	0·8	1·1	1·2	6·2	0·2
Carrots	88·6	1·0	1·1	1·3	7·6	0·4
Cabbage	90·5	1·4	2·4	1·5	3·9	0·4
GRAINS AND OTHER SEEDS.						
Maize (all varieties)	10·9	1·5	10·5	2·1	69·6	5·4
Sorghum	12·8	2·1	9·1	2·6	70·0	3·6
Barley	10·9	2·4	12·4	2·7	69·8	1·8
Oats	11·0	3·0	11·8	9·5	59·7	5·0
Wheat (Spring varieties)	10·4	1·9	12·5	1·8	71·2	2·2
„ (Winter varieties)	10·5	1·8	11·8	1·8	72·0	2·1
„ (all varieties)	10·5	1·8	11·9	1·8	71·9	2·1
Buckwheat	12·6	2·0	10·0	8·7	64·5	2·2
Soja bean	10·8	4·7	34·0	4·8	28·8	16·9
Cow pea	14·8	3·2	20·8	4·1	55·7	1·4
MILL PRODUCTS.						
Maize-meal	15·0	1·4	9·2	1·9	68·7	3·8
Corn and cob meal	15·1	1·5	8·5	6·6	64·8	3·5
Oatmeal	7·9	2·0	14·7	0·9	67·4	7·1
Barley meal	11·9	2·6	10·5	6·5	66·3	2·2
Wheat flour	12·4	0·5	10·8	0·2	75·0	1·1
BY-PRODUCTS AND WASTE MATERIALS.						
Maize cob	10·7	1·4	2·4	30·1	54·9	0·5
Maize germ	10·7	4·0	9·8	4·1	64·0	7·4
Barley screenings	12·2	3·6	12·3	7·3	61·8	2·8
Malt sprouts	10·2	5·7	23·2	10·7	48·5	1·7
Brewer's grains (wet)	75·7	1·0	5·4	3 8	12·5	1·6
Do (dry)	8·2	3·6	19·9	11·0	51·7	5·6
Wheat bran	11·9	5·8	15·4	9·0	53·9	4·0
Wheat middlings	12·1	3·3	15·6	4·6	60·4	4·0
Wheat shorts	11·8	4·6	14·9	7·4	56·8	4·5
Wheat screenings	11·6	2·9	12·5	4·9	65·1	3·0
Cotton-seed meal	8·2	7·2	42·3	5·6	23·6	13·1
Cotton-seed hulls	10·4	2·6	4·0	44·4	36·6	2·0
Linseed meal (old process)	9·2	5·7	32·9	8·9	35·4	7·9
Do (new process)	10·1	5·8	33·2	9·5	38·4	3·0

Farm Section.

FENCING.

THE following notes are from *Practical Dairying for Australia, and the information is confirmed by reports furnished during the month of December, 1896, by over eighty officers stationed in country districts.

Fencing has been subject to many changes during the last twenty years. Wire—plain and barbed, iron and steel—now has an important part in nearly all Australian fencing. The man who has no money to buy wire, and not sufficient time to do good work with posts and rails, must perforce be content with brush fences, which are merely piles of timber, large and small, placed in lines. The heavy logs are drawn into position by bullocks or horses, and the light stuff piled over the logs until there is a rough breastwork about 4 feet in height. Many a good paddock has been enclosed in this way; but where capital and time are available brush fences are to be avoided. They occupy much ground, are dangerous when fires are about, and harbour all kinds of vermin. Much good temporary fencing can be done with saplings used in various ways.

Autumn is the best season to fell timber for farm purposes. One of the first lessons a young bushman should learn is how to fall a tree, and how the tree will fall. You may test the splitting qualities of the tree by taking a chip from it with the axe. If the chip shows a straight grain and divides easily, you may trust the tree to give you posts or rails. It will require good straight timber to give 9 or 10-ft. rails. Many trees which will not do this will be good enough to yield posts, say, of 6½ to 7 feet in length. You can judge by the appearance of the branches if the tree is sound in the heart. A practical bushman can tell a hollow tree by the sound which is produced by a tap of the axe on the trunk. If there are dead, hollow branches atop, your tree is certainly hollow in the trunk. Commence your falling cut, either with axe or saw, on the side the tree is likely to fall. When you have cut half-way through, commence at the other side. When your tree is about to fall do not bustle yourself; keep close to the butt until the tree is fairly canted, then take your tools and quickly move back some yards in a direction opposite to that in which the tree is falling, lest there should be a set-back caused by a jump from a branch. In all cases notch a ring of bark off the trunk before sawing. Split your tree-trunk from the top end. Mark the line you wish the division to take by using a mallet and small wedge. When you have the line marked, which means when you have started the work by making the wedge do a clear line of division, you can, by using two fine wedges, burst the log. You will find that once the log is quartered or divided according to the shape presented,

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* By J. P. Dowling, assisted by F. M'Caffrey, Department of Agriculture, 1893.

that the backing off is an easy matter. A common wedge-axe materially assists the splitter in his work. A month in the bush with a good preceptor will leave the new settler with a mass of knowledge of a kind which books cannot impart.

Look at the settlements around, and make up your mind as to which are the best fences. What seems good enough for your purpose measure carefully, and make your gauges. In the ordinary two and three-railed fences you will find the rails about 9 feet in length, so that two panels usually make a rod, or 5½ yards. The top of the top rail will be from 4 feet to 4½ feet from the ground. The distance from the top of the post to the top of the top mortise will be 6 to 8 inches. The gauge for the mortise-holes will be made in accordance with the width of the rails, and this can best be done by the observation of fences, as suggested. Some good bushmen say that posts placed with the butt ends up last longer than others. The depth of the posts in the ground depends on the nature of the soil and the style of fence; 18 to 48 inches may cover the range. A three-railer post is usually 24 inches in ground. In giving out a contract for fencing you will require written agreements to pass between the parties, stating by whom the line is to be cleared, the dimensions of the fence, timber to be used, depth of posts in ground, and how posts are to be prepared, how the timber and other material is to be hauled, and when the fence is to be completed. You will learn from the Land Agent of the district the rules regarding the boundary fences, and what is considered in a legal sense a fence. It is well to have your fencing lines well clear of timber, so that storms may not cause vexatious smashes; and keep dead timber off the line, so that bush fires may be the more easily checked.

Chock and log fences, zigzag fences, double posts and saplings, and basket fences, are all of a cheap rough-and-ready kind, examples of which may be readily seen in various parts of this Colony. Some of them can be made so as to last for years, but for the greater part they are not so reliable or economical as post and rail or post and wire of good descriptions.

In some of the central districts during recent years good dividing fences have been made with posts erected 10 feet apart, 4½ feet out of ground, and three barbed wires stapled on to the posts. Barbed wire is about 13s. to 15s. per cwt. in Sydney, and a cwt. will reach from 450 to 650 yards. Put the cost landed on the farm with staples down as 20s. per cwt., and it will be seen that quarter of a mile of such fencing will cost for wire not more than £3. Post and rail ordinary fences vary in cost from 2s. 6d. to 7s. per rod.

For barbed-wire fencing the posts, 8 in. x 4 in., are 4½ feet out of ground, and 22 inches in. Three barbed wires are stretched and fixed so that the spaces are exactly 18 inches each. The lower wire is stapled on to the post 18 inches from the ground. The middle wire is stapled 18 inches from the lower one, and the top wire, which is the last put on, is stretched along the top of the posts, to which it is secured by ties of wire. A staple will not hold in the top of a post, as it has to be driven with the grain of the wood. To overcome this a hole is bored 3 inches below the top through the post, and through this hole a fine wire, No. 14, is passed, with which the barbed wire is tied, so that it rests on the posts.

This three-wire fence will do well for cattle. If you desire to make it sheep proof, bore the posts for three ordinary wires, so that the position of the six wires will be as follows:—Ascending from the ground line, 6 inches up a plain wire, 6 inches a plain wire, 6 inches a barb wire, 9 inches a plain wire, 9 inches a barb wire, and 18 inches a barb wire; total for six wires, 4½ feet. The line for such a fence of three wires was cleared, all the splitting, carting, and erecting done at 1s. 9½d. per rod. There were two posts to the rod. No. 14 wire was used to tie the top wire to the posts. The straining posts were 3 feet in ground.

The best of all woods for the man who, regardless of a little extra expense, wishes to put up an A1 fence is ironbark. Posts, 8 x 4, 2 feet in the ground, and charred; 9-ft. panels, seven wires, straining posts 12 in. all over and 30 panels apart, and you have a fence that will last until an earthquake comes along the line.

The cost depends, as in all other cases, on local conditions, distance stuff has to be drawn, cost of carriage of wire, labour, &c. But it will not be very far out to average the total for erection at, for inland districts where good splitting ironbark is becoming scarce, £28 per mile. On the table-lands the same description of fence can be erected with stringybark for £22, bar, of course, cost of wire. In inland Australia perhaps the main fencing timber is box (both narrow and broad leafed), with pine, ironbark, and belar to follow. For a long time there was a prejudice against pine as compared with hardwood. But posts of the cypress pine have been taken up as sound as a roach, bar an inch of shell, after being in the ground 15 years. If they had been charred, doubtless the whole of the 2 ft. in the earth would have been sound throughout. With plenty of timber in your post—say 9 x 4½ in., and good, sound hardwood strainers at every 25 panels, you have a fence that will last for generations. Posts should be 9 feet apart, charred, and, above all, barked. Never was falser economy in the long run than the attempt to save a pound or two per mile in 20-ft. panels and tremendous lengths of strains.

Pine, too, is the easiest wood in the bush to work. You can get your posts for 10s. a hundred as against £1 or 25s. for hardwood. Pastoralists, as a rule, have now fully recognised its capabilities as a fencing timber. Of course, for rails it is comparatively useless. Belar is mostly only used when no other suitable wood is procurable. It splits badly in the summer heats, is, when seasoned, hard to work, and does not stand the ground well.

Myall, yarran, gidyea, boree are certainly used as posts, but only when nothing else is procurable. They are, as a rule, gnarled, knotty, uncomfortable timbers to do anything with, and it is difficult to make a job look well where they have been employed. Of all fences the post-and-rail is the most expensive. It is also in many districts, especially the sheep ones, becoming a thing of the past. Before the advent of wire brought about such a change the man who could afford it erected proof fences of five and six rails; those who could not, put up brush or log. It is a rarity now to come across a new four-rail fence.

The battened skeleton fence of four, five, or six wires with 15-ft. panels, there being two or three battens attached to the wire between each post, is a barrier which has recently been popular, but it is not what a dairyman should erect.

A good boundary fence for cattle can be made with a top-rail and three wires. Posts in ordinary country should be in ground about 2 ft. Where black soil forms part of the farm, 2 ft. 6 in. will not be too deep for post holes, as the fences are apt to sag after rain. Rails should be 10 ft. long, well shouldered, and lapping a clear 6 in. through the mortise, filling the latter completely, side and end. The man who has this boundary need not be afraid either of his own stock getting out or stragglers coming in. For cattle three wires are generally enough, but for sheep, even under the top rail, less than six are not of much use, and for crossbreds at least eight wires are necessary.

Throughout the Great Table-land, extending north and south at a distance of from 30 to 100 miles from the coast, timber is plentiful and labour cheap, especially that of the bushman.

In this wide range of country grow trees of every description, both eucalypts and others, many of them as yet but slightly known, and flourishing deep in the gloomy recesses of the coastal scrubs. These latter, growing straight as a gun-barrel to an enormous height, and splitting like a match, are not the best timber for fencing. They are all sap, cutting like cheese, and lasting about as long. After many trials, land-holders throughout the table-land have pinned their faith to the stringybark. It grows plentifully nearly everywhere, and in many places for miles posts can be split right along the line. The average cost of erecting a top-rail fence with wires in these regions is about £25 per mile.

Properly erected, this is an ideal fence for the small cattle-holders who abound in the table-land, not only as a boundary, but for subdividing into the small paddocks which the business, for instance, of the dairy farmer should necessitate. "Should" is written here, because in far too many instances subdividing sufficiently is entirely neglected, and, in place of a dozen small paddocks, two or three large ones are deemed sufficient, even in what are looked upon as model farms.

Six wires, No. 6 or 7, the spaces from the ground being 10, 4½, 4½, 5½, 10, and 12 inches, posts a rod apart, is a fence which has been much used for sheep and cattle. Straining and erecting generally is a trade which cannot easily be learned from a book.* A roller 3 ft. long and 4 in. in diameter, worked by an iron pin or pins put through the roller, will do rough bush work. Boring is done with ordinary small augers, or with frames and augers; straining posts are put deeply in the ground, and are fitted with stays. A few miles of journeying in the interior will give object lessons in fencing.

The farmer should keep a watchful eye on his fences, and recollect that wire fences will often require straining and repairs.

Remember that, at their best, slip-rails are nothing more than make-shifts. The time necessary in lifting the rails up and down can easily be devoted to some useful purpose. Have gates where openings are necessary. About 11 feet is a fair width for the passage of cattle, sheep, or drays. Four bars of inch hardwood, mortised into stout heads with a couple of strong lateral stays, bolted right through, make a capital gate. Never hang gates on the posts of the fence. They are sure in such case to either lift or fall—in fact, follow every caprice of the fence itself. But if a couple of stout posts are sunk alongside the wire or top-rail ones, as the case may be, and the gates hung thereon, they will last twice as long as if attached to the fence itself. A bushman's charge for a 5-ft. 6-in. gate is generally from 7s. 6d. to 10s. Many selectors make their own. If a man isn't "handy" with tools, it is far better to pay someone who is to make the farm gates. The following is said to be an excellent means of preserving posts about the homestead, and has also the merit of being cheap:—Take boiled linseed oil, stir in pulverised charcoal to the consistency of paint, and with an ordinary paint brush give a coating to the portion of each post that is to be placed in the ground. It also acts as a preservative for timber that is exposed to the air. The cost of treating posts with this mixture is about 3d. per dozen.

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* See p. 132.

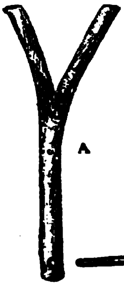

Fig. 1.

Fig. 2.

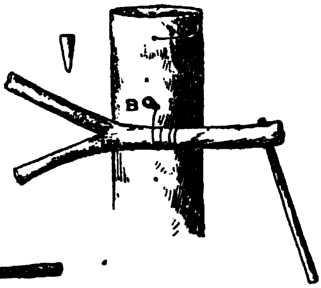

Fig. 4.

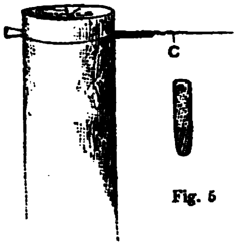

Fig. 5

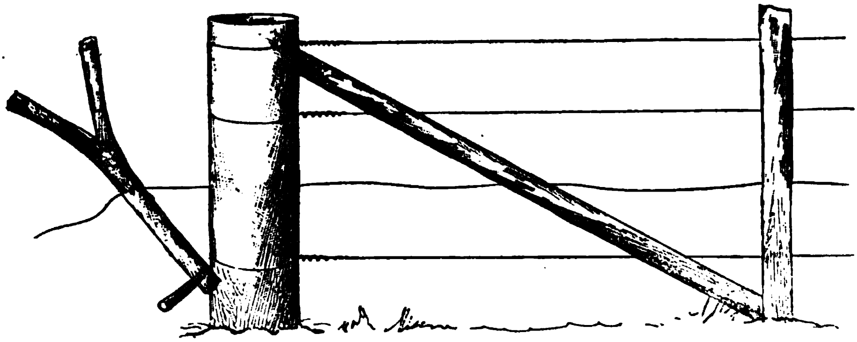

Fig. 3.

* Straining the Wire :—A simple method of straining the wire is by means of a forked stick with a little lever, as shown in figs. 1 and 2. A hole just large enough for the wire is bored at A. The end of the wire (according to thickness of post) is drawn through the straining post and inserted in the hole A, see fig. 3. The forked stick is then wound round by means of the fork and the lever until the proper tension is secured, the spindle being jambed hard against the straining post, fig. 4. A wooden or iron wedge made to fit tight is then driven in at B. This holds the wire while the spindle is gradually unwound and brought round the post, when, to make it fit close against the post, the wire is tapped. The end of the wire is then put in a turn round the main wire. A small bar, fig. 5, with eyelet hole, is then threaded on and run close to the post. The bar is wound round the wire in corkscrew fashion, which will make a tight and neat job. If the line of posts is, say, over fifty posts, it is advisable to strain and plug each end before finally fastening. But it is best to adhere to thirty-panel strainers. It is not advisable to bore the posts before they are in the ground because in erecting, the holes are likely to get out of line which causes difficulty in drawing the wire. Start unreeling from the inside of the coil. The wire comes out more readily, and is not so likely to tangle and kink. In opening a coil be careful to file the binding with the run of the coil, otherwise there is risk of nicking the wire with the file, and a file-nick ever so slight will cause the wire to snap when strained.—E.H., Practical Fencer.

Best drawn fencing wire fluctuates in price. It ranges from about £8 to £9 a ton in Sydney, according to quantities required. The following table shows quantities and weights needed for a mile of fencing:—

Gauge Number.	Weight per Mile.	Yards per cwt.	Breaking Strain.	Diameter.	Weight of Fence per Mile for											
					2 Wires.			3 Wires.			4 Wires.			5 Wires.		
	lb.	yards.	lb.		cwt.	qr.	lb.	cwt.	qr.	lb.	cwt.	qr.	lb.	cwt.	qr.	lb.
4	714	276	2,197	0·240	12	3	0	19	0	14	25	2	0	31	3	14
5	595	332	1,830	0·220	10	2	14	15	3	21	21	1	0	26	2	7
6	495	397	1,528	0·200	8	3	10	13	1	1	17	2	20	22	0	11
7	412	479	1,268	0·185	7	1	12	11	0	4	14	2	24	18	1	16
8	344	573	1,060	0·170	6	0	16	9	0	24	12	1	4	15	1	12
9	290	680	893	0·155	5	0	20	7	3	2	10	1	12	12	3	22
10	241	819	741	0·140	4	1	6	6	1	23	8	2	12	10	3	1
11	186	1,059	573	0·125	3	1	8	4	3	26	6	2	16	8	1	6
12	142	1,393	436	0·110	2	2	4	3	3	6	5	0	8	6	1	10

CLEARING.

The first consideration of the beginner who has selected his site is how to clear the area for cultivation. It is a great mistake to undertake the clearing of a greater area than can be thoroughly accomplished. A few roots or old stumps that do not seem worth taking out are often the ruin of a plough, and as they have to come out soon or later, it will be found cheaper to go over the area carefully and remove everything that is likely to form an impediment to cultivation. Where timber is very heavy, it is often the practice to ringbark the trees and let them rot out. But this is a slow and slovenly method, and the standing trees are a continual source of trouble and expense. It is far more economical to clear the area thoroughly bit by bit as it is required for cultivation.

The timber that is grubbed out can nearly always be utilised for fencing and other purposes, as well as firewood.

Methods of Clearing.—First dig round the base of the trees until the main roots are well exposed. Then cut each large root through. When all the trees or a large portion are ready, all that is required is a bullock team and a strong wire rope. Attach the team to one end of a log and one end of the wire rope to the other, and connect the rope with the trunk or central branches of the tree as high as you conveniently can. This is best done by using a ladder. Care, of course, should be taken that the rope should be attached so that the tree will not break off: Provided that the grubbing has been properly done, no difficulty will be found in pulling the trees down. When the trees are down, saw out logs of about 6 ft. 6 in. long, for splitting into posts. Then cut up what you require for firewood, and burn the remainder. Run the roots, and take out the tap root fully 1 foot deep. Too much care cannot be given to this, as great damage is done to ploughs through their coming in contact with heavy roots. If the timber on the land intended for cultivation has been rung, and is quite dry, most of it can be burned out if the trees are dug round and a fire lighted at the base.

Contracts for clearing are now taken at a very low rate, and if one can afford it, it is wise to clear by contract, as often the work can be done very cheaply by experienced hands.

CULTIVATION.

As pointed out in the preface to this work, variety of soil and natural conditions make it almost impossible for any one to furnish definite advice as to the best manner of cultivating any particular area unless he be on the spot. The way out of the difficulty is for the intending cultivator to make himself acquainted with some of the main principles that are likely to influence his operations; and it is thought that the following extracts from an article which appeared in a recent number of the *Agricultural Gazette*, by Mr. A. M. Howell, will do much to dissipate many of the mysteries that enshroud the subject.

Why we Cultivate the Soil.

Let us inquire first why or for what reason or purpose do we cultivate the soil; why not just dig little holes in the paddock, put a few seeds in each, cover them with earth, and just let 'em grow, without previous or further bother? There they are, why can't they grow and produce a crop without all this stir with the plough, cultivator, and hoe? What's the good of it; how does it benefit growing plants?

Doubtless this is one of the first questions that many New South Wales farmers ought to wrestle with. It is an inviting one, indeed, for many tillers of the soil in all countries, more or less, according to individual knowledge and advancement, dependent to a large extent upon the "state of the country" in agricultural progress. But it is especially a question of vital concern to all who live in so dry a climate as that of this province.

Deep Soil and Moisture.

A goodly number of farmers declare that they dare not plough their lands deep because it opens the way downward for the rain when it falls to "get away." Their idea is to catch and hold it all in one thin layer of soil on top, where the roots of plants can reach it. Has it never occurred to those who hold this erroneous view that the roots of plants follow moisture as well as plant food downward to very considerable depths? To talk of subsoiling land 18 to 24 inches deep is, to this school of farmers, to talk sheer nonsense. And then, in addition to deep subsoiling, to suggest drainage, by ditches or otherwise, of land that rarely gets enough rain in summer to produce a full crop, is, to use a phrase common in America, "piling on the agony."

Let us in this connection apply a little reasoning to the subject of properly preparing the soil and putting it in some sort of condition that it may reasonably be expected to yield remunerative returns, even in a dry climate in a dry season—a season of only moderate rainfall during the growing period, which may mean two or three fairly good showers within about 100 days. Perhaps, to discuss what is deemed the proper course to pursue will abridge matters, and better serve to show the futility of the plan of catching and holding the rain at the surface by not breaking the subsoil.

Air, Water, and Drainage.

In the first place let the assertion be carefully noted that air is as necessary to the growth of all ordinary crops as water. Plants cannot live without it. It is to be feared—nay, it is literally true—that very many farmers are utterly oblivious of this fundamental fact. Nevertheless it stands boldly out as one of the very ground principles of advanced agriculture that the *roots* of plants must have air or they cannot grow—that is, all our field crops except such as are aquatic by nature. Exclude the air from the roots of plants by any means whatsoever—by a solidly compacted impervious soil, or shut it out by constant saturation with water, and the inevitable result is the same in either case, suffocation, asphyxiation, or drowning, which are all practically one and the same. The plants languish and die, or drivel into unfruitfulness. All experience and actual experiments prove it, and in cases of partial suffocation, as by poor or imperfect cultivation and little or no æration of the soil, or partial water-logging in seasons of excessive rainfall and no drainage, the damage to the crop is in direct ratio to the extent of the retarding and destroying evil. The beauty of it is that draining and opening up the soil to whatever depth it is possible to plough it obviate the trouble in either case by letting in and out both air and water. Draining of course prevents saturation. The question of necessity for drainage depends largely upon the character of the underlying strata. If of decomposed granite or other open formation an excess of water will soon pass down, followed by a sufficient inrush of air; if of close waxy clay the excess will be very slow in its descent and injury to the crop will result. It is obvions that the latter soil especially should have efficient drainage.

The Effects of Drainage.

It may be noted at this point that drains, be they ditches at intervals, under-ground tiling or box tubes, blind ditches (ditches systematically filled with logs of wood, poles and brush, and covered over with earth) or others, do not do more than carry away the *excess* of water from the soil. They do not dry out the soil as many thoughtlessly believe. There is no flow of water through drains after the excess, in the strictly proper sense of the word, has passed off. After this has been done the soil then holds in its minute interstices all the water that the roots of plants require, and as much as they should have, with due regard for healthy growth. This residue, constituting the adequate and proper supply, does not travel downward. It remains by adhesion to soil particles in the soil interstices until sucked up by the roots of the crop, or is drawn to the surface by capillary force and evaporated into the air. The soil in the condition just described is now, if previously well broken, in fine order, containing a sufficiency of both water and air, and with favourable sunshine the crop occupying it will "fairly jump."

Air Supplies Moisture.

In a deep finely divided soil into which air can percolate freely the amount of water carried into the soil by the air, although invisible to the eye and perhaps to the feel, is very considerable. The fact that crops are greatly nourished from this source is but little known or appreciated by many farmers. Without this *dernier ressort* many crops that are by it tided over a serious drought, until rain comes to the rescue, would famish and die. Hence the inestimable value of a deep finely pulverized soil well supplied with humus (vegetable matter). Were the importance of the subject generally understood farmers would be more careful and thorough in the preparation of their soils for all crops. Especially is it desirable on this account that high-lying uplands, which are severely subjected to the sun's rays and to the hot, drying winds, should be prepared in the most thorough manner before they are planted or sown to any crop.

There is water in the air at all times and at all places in the form of unseen vapour. It is the source of dew which is condensed from this vapour right where it is observed in the early morning. Instead of falling from the heavens, as many suppose, it is the warm, watery vapour of the air, condensed into actual water by coming in contact with the surface of the cooled earth during the night. Is it not plain, therefore, that if the water-carrying air be permitted to circulate freely through the soil during the night, it supplies the thirsty plants' roots with a refreshing drink that strengthens and invigorates them, and enables them to hold up against the next day's parching sun? Says Johnston, "In the hottest and most drying weather the soil has seasons of respite from the scorching influence of the sun. During the cooler season of the night, even when no perceptible dew falls, it has the power of extracting from the air a portion of the moisture it had lost during the day. Perfectly pure sand possesses this power in the least degree; it absorbs little or no moisture from the air. A stiff clay, on the other hand, will in a single night absorb sometimes a thirtieth part of its own weight, and a dry peat as much as one-twelfth of its own weight; and generally the quantity thus drunk in by soils of various qualities is dependent upon the proportions of clay and vegetable matter which they severally contain. Humus has the greatest power of absorbing moisture from the air. The addition, therefore, of a manure containing large quantities of organic matter, as farmyard manure, increases this power in the soil."

Other scientific authorities of renown support these views from experiments made by themselves. All favour the deep breaking of the soil and the supplying of humus in large quantities.

The Good of Deep Ploughing.

In view of the foregoing data and utterances from the highest authorities, can there be left any doubt in the minds of any who read them that the thing to do to combat drought is to deepen the soil by subsoiling, and to provide it with all the vegetable matter that can be scraped up from all sources? Subsoiling very greatly enlarges the capacity of the soil for receiving, holding, and utilising both water and air. The advantages of deep soils and deep stirring may be summed up as follows:—The deeper the soil the greater the quantity of water it can take in and retain, the longer it will sustain plant life, the better does it perform the function of chemically decomposing new materials into available plant-food, and the more easy is it kept in the very best state of tilth.

Hard-pan and Capillarity.

An open and well-cultivated soil has also great power to draw water from lower depths by the force of capillary attraction, and in the underlying strata of many soils there is an abundant supply only a few feet down, or continuous with increasing density from the topsoil downward. There is no doubt whatever that soils and crops receive very material aqueous nourishment from this source during seasons of dry weather.

This power of the soil to suck up water from below is seriously crippled, however, in very many instances by what is termed "hard-pan." Indeed, hard-pan is a common evil, especially among the many who are afraid to plough deep, through fear that they will puncture the bottom and let the water out. Now this bottom, or hard-pan, will be formed at whatever depth the soil is continuously ploughed to. This being unquestionably true, why not place it as low down as possible—18 inches instead of 4 to 8 inches, and thus make the soil the former instead of the latter depth? Will not the capacity of the soil thus be quadrupled, or more than doubled for holding moisture, and for production? Rest assured the hard-pan will be and remain just where you place it by ploughing every time to the same depth, the point of the plough scraping over and plastering, as if with a trowel, the same under-surface every time the land is broken. This hard-pan, at whatever depth it may be, soon becomes, in tenacious soils, practically impervious to water and air, upward or downward, and to the roots of plants It therefore measures the depth and capacity of the soil in which your crop must grow. The deeper the soil above the hard-pan crust, and the more finely pulverised, the greater is its efficiency, in several senses, to support a crop and bring it to maturity.

Subsoiling.

No intelligent, thoughtful farmer need be reminded that the subsoil should only be broken and let remain in its place, and in no case brought up and admixed with the topsoil. In the course of several years' cultivation, portions of the topsoil will have slowly worked downward and become partially enmassed with the broken subsoil, which in the meantime will have been acted upon by air and water and frost, and become chemically and mechanically transformed into "good" soil. The result will be that you have a good soil down to hard-pan as deep as you choose to make it—a soil that, if deep enough, will carry the crop safely through any ordinary drought.

The Subsoil Plough.

The subsoil plough should be a thin, sickle-like coulter, hooking forward, with a keen, piercing point that will, if properly set, pass through the soil in an almost horizontal position. The point should be only slightly winged or flanged—the narrower the less the resistance of the soil, and the deeper it may be made to run. Imagine a gigantic fish-hook, with its shank strapped to a 6-foot beam of timber with handles, and you have the proper conception of a good subsoil plough. This implement should follow in the same furrow immediately behind a single-furrow turn-plough. Subsoiling should be done in two directions, at right angles or diagonals for the best results, which in a soil either naturally or artificially drained—at least, not water-logged, will show themselves the first year in a marked degree.

Further remarks upon the importance and value of deep and the most thorough breaking up of the soil, with drainage where necessary, as above indicated, would seem to be a waste of argument and space. The old saying that "good preparation is half cultivation" falls far short of the mark. It is considerably more than half in the valuation of results. Let it be said, in concluding this branch of the subject, that it is to be sincerely hoped that the old and the too common notion of shallow cultivation for the conservation of moisture for a growing crop, more especially in this dry climate, will soon pass into the category of antiquities.

Shallow Summer Tillage.

The summer treatment of crops should, of course, be shallow—the mere sweeping of the immediate top surface. This is not, properly speaking, the cultivation of the crop, but protecting it from the inroads of its natural vegetable enemies, grass and weeds, and preventing the escape of the moisture that the first and real cultivation has provided. Surface sweeping thus performed with the cultivator (scarifier) serves to mulch the soil with a thin layer of dry earth or dust, through which air percolates downwards into the soil, and which largely prevents evaporation under a hot sun. The method is the generally recognised practice in the Cotton States of America where, notwithstanding the usual ample rainfall, destructive droughts often occur during the growing period, and evaporation is rapid from the light sandy soils of the cotton plantations. The sweeping of the surface is done as often as the force employed can go over the crop of the farm, even when no rain has intervened, and when the inexperienced would deem it a profitless and utterly useless expenditure of time and labour. Years of trial, however, have proved its efficacy in attaining the results aimed at. It can hardly be questioned that the cultivated crops in this climate are as largely benefited by it, when the drought is on, as the cotton of the States. Every farmer ought to test the matter by experiment.

The Use or Non-use of Manure.

It is easy to see that in such a hot climate as that of New South Wales, and especially where the cultivation is comparatively shallow—often not more than 4 inches—that the use of *fresh* animal manures and highly ammoniated fertilizers may be injurious if applied to the soil in the spring, just before the crop is planted or sown, causing the plants to burn or "fire" in the absence of sufficient moisture. Such manures generate in the soil considerable heat, which is not only not needed but is decidedly hurtful to tender vegetation, the soil being perhaps already too hot for it naturally, under the generally prevalent circumstances of dry soil, comparatively dry atmosphere, with the mercury above 100° F. What then is to be done with the considerable quantities of valuable fertilising materials to be seen on almost every farm? What is the proper course to pursue to utilise this natural product, every pound or shovelful of which has a money value in almost every country on the globe? The study of most peoples is how to convert all such natural resources into available wealth, and let nothing go to waste. The English or American farmer whose soil is frequently saturated with rain could answer the question in a moment were these accumulations on or near his own premises. Certainly the farmers of the Colony know its fertilising value, and under a system of deep instead of shallow cultivation they would soon realise the fact that it can be safely used by mixing with humus, and ploughing it into the soil in autumn. The vast quantities of humus, in the shape of grass, dead weeds, litter, trash of every kind, muck from the bottoms, &c., that may be collected on every farm, is something astonishing. The proprietor himself will wonder where it all came from. If all this stuff be piled in a moist state, and mixed with all available animal excrement and a small quota of gypsum, and the mass, after a month's fermentation, spread upon the land, and ploughed under during fall or winter, who can doubt its efficacy, not only in supplying plant-food for spring and summer crops, but in fortifying the soil against drought? Rotted manure—a very different thing from fresh, unfermented manure—and humus—vegetable matter of every description, including the decomposed bark and chip accumulations of the wood-pile—are unexcelled as absorbents and conservators of moisture and fertility, and there is nothing better for the improvement of the texture of either clay or sandy soils. A rank growth of any green crop, ploughed in after partial maturity, supplies humus in large quantity, and is, perhaps, in some portions of this country, the cheapest method of improving the soil.

The Intense System of Farming.

A system of deep subsoiling, coupled with drainage where necessary, and supplying humus in considerable quantity yearly, as above hinted, will very soon bring soil up to a state of fertility and independence of drought ten times the value of the unimproved land. That is to say, it will by such improvement have ten chances to one in the certainty of producing a crop, and will, at least in the course of a few years, produce ten times the produce, of ten times the cash value of that which comes from it in its natural state under prevalent methods of cultivation. To some farmers, who have never studied or experimented in the improvement of the soil, this assertion as to results will be received as of very doubtful credence. They will not believe it until they see it. Many have never had the opportunity of seeing crops produced under the "intense system" of farming, which is the only rational system. Perhaps the enormous yields of some lands in crops and in cash returns in the vicinity of the large cities of the world would be inapplicable to cite in a discussion of the subject with the colonial rural farmer, whose markets are more or less remote; but little research is needed to find examples of what has often been accomplished on the strictly country farm with purely agricultural crops—not vegetable and fruit crops of great value, grown in the suburbs of cities, but crops which have to be regularly harvested, housed, and prepared, and sold in the world's markets.

The Colonial Policy.

Many readers will doubtless opine that "intensive" farming in most of the districts of the province cannot be done except under a perfect system of irrigation. Perhaps this is true in a qualified sense, but until irrigation becomes available at some future time, why not adopt and practice the next best methods—provide your crops, with a deep, humus-laden, water-holding soil; use all available manure materials and fertilisers, and cultivate a few instead of many acres. A good beginning in this direction will revolutionise the agriculture of the Colony, and establish it upon a higher and more prosperous plane. The true and wise policy of the New South Wales farmer would seem to be in the direction of the intensive plan of culture as the surest way to meet the exigencies of the ever-menacing drought. By it really more farm produce will be grown than by old-fashioned methods, at less expense, and with far greater certainty of a remunerative yield every year. It is feasible and practicable, and the pleasure of producing royal crops annually infuses new life into the farmer. His acreage will be less, but the net returns greater. Along these lines lie the bread-producing future of the Colony, upon which the general welfare in no small part depends.

Water Supply.

Unless the settler is fortunate enough to secure a holding having a permanent natural water supply, this is a subject of grave importance.

For domestic purposes enough water can usually be obtained from the house-roof, but for stock a tank sufficiently large to meet all requirements for at least six dry months should be provided. If there is a good fall do not throw up your dam or excavate the tank right at the lowest corner of the holding. Always endeavour to choose a site that will allow of the water being drawn off by gravitation. It is false economy to leave the tank unfenced, because if the stock have to wade in to drink they will soon pollute the water. The best plan is to fence the tank round with barbed wire, and at the lower end of it use an old piece of bent piping, syphon fashion, with a tap on it. A drinking-trough can be made with little trouble, and just as much water as your stock require can be drawn off without any labour at all. By the exercise of a little judgment races can be cut by turning up a couple of furrows with the plough and shovelling the soil out to collect surface water for the tank.

THE PLAN OF THE FARM.

A VERY important thing in starting operations is to make a rough plan of the place, laying it out as seems best, and then build and fence accordingly. This will save a great deal of time and trouble in the future, as one is almost sure to put things in the wrong place and keep removing them if there is no plan to work by. A good, dry, healthy site should be selected for the homestead, and as central as possible, with a good-sized yard a little distance from the house, with stables, cow-sheds, and other buildings needful; machinery-shed and granary built separate, and in a clear space, some distance from the house and yards, while the stack-yards should be arranged so as not to have too much stuff in one place in case of fire. A few ornamental trees about the house and yards will provide shelter in winter and shade in summer, as well as making the place homely. Live hedges about the place also add to the appearance of the farm. Of course, all these things will take years to fix up, but plan them out beforehand. It seems scarcely necessary to add that every homestead should have a little fruit and vegetable garden.

In laying out the paddocks due regard should be paid to the requirements of alteration. Always leave plenty of horse-room, so that when a crop needs scarifying during a dry spell and so on, the implements can be effectively worked.

Mr. T. C. Worboys, who may be regarded as one of the most successful general farmers in the Colony, says: As soon as the crops are off plough up the land at once, or run the cultivator through it. This will stop all weeds and rubbish from growing, and put the farmer in a position to sow or otherwise deal with the land when the proper time comes, irrespective of the weather. A great many farmers never plough until they want to sow, and if the weather is a little unfavourable, and the ground hard, they have to wait for the rain, with the result that often the best of the season is gone, and they get behind, not only in the seed time, but in the returns as well, because late crops, as a rule, are never so profitable as early-sown crops.

WEEDS.

THE following notes on the extermination of weeds are furnished by Mr. J. H. Maiden, Government Botanist and Director of the Botanic Gardens:—

We should remember that thorough eradication is the first main expense.

Prevent a weed seeding. Destroy it in flower or early fruit.

Persistently cut down weeds growing in the paddocks, remembering that this causes atrophy of the root, and consequently the plant dies out.

Cut a weed a few inches below the surface, as cutting at the surface by a scythe, &c., causes many weeds to form lateral branches, often with a tendency to lay flat on the ground, thus adding considerably to the difficulties of extermination.

Weeds are sometimes dealt with by sowing crops which smother them. Change of crop is often useful, and particularly the introduction of root or other crops requiring hoeing and scarifying.

A mechanical extractor is sometimes useful. A useful one for large weeds with stems of the necessary toughness is figured on page 814, volume 2 (1891), of the *Agricultural Gazette.*

The use of chemical exterminators, such as salt, kerosene, &c., is usually out of the question, as the labour is too great, to say nothing of the cost of materials. This method is also uncertain, and, as a rule, can only be applied to special weeds, *e.g.*, prickly-pear.

Mr. Maiden advises agriculturists to forward specimens of weeds to the Department for identification.

Cereals.

WHEAT.

G. VALDER,
Principal, Hawkesbury Agricultural College.

In selecting a site for wheat-growing it is advisable to bear in mind that land on which the timber has been rung is far more valuable than land on which the trees are still growing. The reason for this is that—

1. It is much cheaper to clear it, land heavily green timbered often costing 40s. per acre, and land of the same description rung 10s. per acre.
2. In burning off green timber large quantities of vegetable matter are burnt up, which, in the case of dry timber, would have rotted, and be ploughed in.
3. There is always a sourness about land recently cleared of green timber which much affects the first crop, and is especially noticeable in dry seasons, which can only be remedied by fallowing the land for at least six or eight months.

Enormous areas of red and black soils throughout this Colony are found to be specially adapted for wheat-growing, heavy crops of grain and hay being obtained in districts where a few years ago it was considered impossible for a farmer to make a living. Wheat is a very hardy plant, and it will stand great reverses, provided that it is on suitable soil, and, therefore, but little trouble should be found in selecting the position of a wheat farm when once it is seen the soil is suitable. Of course, if possible, it is wise to choose a site having good natural drainage.

Ploughing.

It is very difficult to advise as to depth of ploughing, as soils vary so in depth and character that what would apply to one farm would be ruinous to another. Some soils would do best if ploughed 8 inches, while others should not be worked deeper than 4 inches. I find that, as a rule, farmers are inclined to plough too shallow, in some districts scarcely a single paddock being ploughed deeper than 4 inches. From experiments conducted at Wagga I am inclined to think that far better results would be obtained by ploughing at least 6 inches. Of course much depends on the farmer's judgment, and if he were to plough portions of his land at different depths much good information would be derived from the experiment.

Sowing.

Although at present nearly all wheat crops in this Colony are sown broadcast, I am confident that the time will soon come when the greater portion will be drilled in. The drills at present in the market are not as fine in their work as I would like to see them, being mostly built to sow from one to three bushels per acre, whereas a much smaller quantity than a bushel is quite sufficient for an acre. For broadcasting, one bushel to the acre is quite sufficient. Sowing should be as early as possible—May or June at the very latest. Early-sown wheat is better able to withstand attacks of red rust, and one has only to compare the early and late sown crops in a dry season to realise the advantages of the former system.

Varieties to Sow.

Purple straw is the variety mostly grown in this Colony, and although it is a suitable wheat in many ways it makes a weak flour, and I would advise that the following varieties be tried in preference :—Australian Talavera, Berthoud, and White Lammas for main crops, together with smaller areas of Allora Spring, King's Jubilee, Early Para, and Steinwedel. Of the bearded wheats, Early Baart and Algerian are worthy of trial, both being great croppers. Early Baart is a good milling variety, and is very suitable for hot, dry climates. Algerian is a bad milling variety, but makes very good pig and poultry feed, and is especially suitable for growing in the coastal districts.

Selection of Seed.

Too much care cannot be given to this matter. Often we hear a farmer say that any seed will do, but experiments have proved over and over again that by far the best results are obtained by using nothing but large plump grain, and it stands to reason that such should be the case. I would, therefore, advise all farmers, when buying seed, to take nothing but large, plump grains ; or, if they are obliged to take what they can get, as is often the case, I would strongly urge them to screen out the smaller grains.

* Treatment of the Seed for Smut.

Great losses are often experienced from the disease known as smut, ranging from 10 per cent. to often half the crop or more.

Remedies.

1. Avoid seed from smutted crops and smutted regions.
2. Promote a quick and vigorous germination of the seed.
3. Avoid for wheat farm-yard manure produced by the use of smutted wheat either as food or bedding.
4. Treat the seed with hot water. Provide two kettles, wash-boilers, or galvanised-iron tubs, capable of holding ten times as much wheat as it is desired to dip at one time. Provide also a thermometer and a basket or receptacle made of wire mosquito-netting; this latter is to hold the wheat, and must have a cover capable of being fastened on. The treatment can also be accomplished in coarse gunny-sacks or chaff-bags. Fill the basket or gunny-sack or chaff-bags three-fourths full of wheat, and then prepare the hot water as follows :—Take a volume of water fully three times as great as the volume of wheat to be treated, and place it in one of the two tubs already mentioned. Take an equal quantity of water and heat it to the boiling point. When it boils, pour nearly the whole (four-fifths) of it into the cold water; the result will be water whose temperature will be about 132½° Fahrenheit, which is the proper temperature. Plunge the basket of wheat into this water and keep it there fifteen minutes, lifting, plunging, and rolling it every

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* Full particulars *re* Rust have been published in *Agricultural Gazette*, and copies of Dr. Cobb's articles can be had on application to Department.

moment or two. Do not allow the water to get below 130° or above 135°. When it gets below 130° add boiling water, at the same time lifting, plunging, and rolling the basket or bag to mix it in. When the fifteen minutes is up plunge the basket or bag of seed into cold water. Lay the seed out to dry if it is not to be sown at once. One man with the apparatus here described, treating about three-fourths of a bushel at a time, can treat 20 bushels per day, and with practice, 40 bushels.

5. Formerly various chemical treatments of the seed were in vogue for the prevention of wheat smut, and they continue to be yet used. Sulphate of copper (bluestone), sulphate of copper with lime, lime alone, brine alone, have all been much used. Brine may also be said to be no longer used; lime alone is also now seldom used; but sulphate of copper or sulphate of copper with lime continues to be the treatment adopted by many good farmers, though these methods are giving way to the Jensen hot-water treatment. Half a pound of bluestone in 12 gallons of water makes a solution containing one-half per cent. of bluestone, the strength latterly recommended. The seed is soaked in this solution for twelve to fourteen hours and then dried; or, after the above soaking, the seed is put into a milk of lime made by slacking lime in ten times its weight in water, and is then dried.

6. A rotation of crops doubtless tends to reduce wheat smut. In long-settled agricultural districts scarcely any practice is to be more strongly condemned than growing the same crop year after year on the same land.

7. Good drainage gives a quality to the plants which enables them the better to resist the encroachments of smut.

8. Do not buy seed except under guarantee that it comes from a clean crop.

Rolling and Harrowing the Crop.

Much controversy has taken place with regard to this subject. From my experience I am inclined to think that rolling is advantageous in many instances, but I would nearly always advise that the roller be followed by the harrow. In the hot dry districts, land which has been rolled is nearly always liable to cake and therefore the moisture evaporates very quickly, but if the harrow is put over after the roller the surface is left loose and the moisture is retained in the soil. This is, of course, a great advantage as in many seasons the rainfall is deficient, and it is therefore desirable to take every precaution to conserve what does fall. Another advantage of keeping the surface soil loose is that the rain goes right into it, whereas, if the soil is caked most of it runs off.

Attention should be given to the growth of different varieties for different districts. A variety that would suit the warm dry district of the Riverina would very likely be unsuitable for such a cold district as Cooma, and therefore, it would be wise for a beginner to communicate with the Department before buying seed of any variety.

In this Colony it has been found difficult to carry out a system of rotation similar to that carried out in Europe, but from the experiments at Wagga Wagga I am convinced that the following is a system which should be very successful here.

Divide the land intended for cultivation into four equal or nearly equal blocks; say that the area is 400 acres, we then have four blocks of 100 acres each. Spell one of these blocks every year, ploughing it up at the same time as the other land. In the Spring (end of September or early in October) sow Cow Pea either in drills or broadcast. When the plants are in flower, or commencing to pod, roll them down and plough in. Or another method is to eat the plants off with sheep or cattle, and then plough. I am confident that if this system be adopted, we shall not hear so much talk about worn-out lands, and that at the end of ten years the farmer would get more off the 300 acres than he would have done had he cropped the 400 acres every year. Besides this, I believe that the land would be just as good as ever.

Much good would result from the judicious use of artificial manures, especially blood manure and bone-dust, which can often be purchased at a very low rate from the meat works; but the average farmer does not care about, and often cannot afford to risk, the expenditure; for if the season should happen to be a hot, dry one, the manure will often do more harm than good; but all the same, it will make up for the expenditure the second year, and no doubt, in the long run, will pay well.

BARLEY.

BARLEY requires a rather rich and friable soil, and therefore in planting a crop select, if possible, land in which the mould-board of the plough cleans. Often good crops can be obtained on clay loam, provided that the land is well and deeply worked. Unless the land is evenly worked the crop will ripen unevenly, and the sample produced will not be a good one for malting. The local market for malting barley is only a limited one, and therefore, before putting in a large crop, it would be advisable to make some arrangements with the local brewers as to disposal. If growers were to combine and send large shipments to the English market, no doubt malting barley would be a profitable crop.

Sowing.—In large trials conducted at Wagga Wagga it was proved that seed drilled in at the rate of half a bushel to the acre produced by far the best yield and best grain. The drills were 8 inches apart, and the machine used put in eleven drills at a time. Early sowing is preferable for barley, May being about the most suitable month. Carter's Prize Prolific and English Chevalier are about the best varieties.

For feed purposes the variety known as Cape Barley is about the best, being very hardy, quick in growth, and a heavy cropper. It is also a first-class variety for ensilage. About 2 bushels broadcast are generally sown for green feed.

Skinless barley is also a valuable variety for green feed, being very early and a heavy cropper. It is largely grown in California for hay, a purpose for which I consider it is valuable here.

For putting in a crop of malting barley, when a drill is not available it is best to sow about 1¼ to 1½ bushel of seed per acre.

There is a small local demand for good, full samples of barley for pearling. Chevalier is about the best for this.

OATS.

Only in the cooler portions of the Colony are oats grown in large quantities for grain, and even this supply is not nearly sufficient for requirements. As a consequence, large quantities of grain are imported from New Zealand, Tasmania, Victoria, &c. So far, the most suitable variety for growing in the drier districts, and also in Victoria, is Algerian. Of late this variety has been largely grown in the Riverina for hay, with very satisfactory results.

Brown Calcutta, White Tartarian, White Canadian, and several of the Texas varieties also appear to be very suitable for the drier districts.

Oats are very liable to smut, the treatment for which is exactly similar to that for wheat-smut.

When the weather is favourable it is very important that oats should be sown early, especially in the hot, dry districts. The cultivation required is much the same as for wheat. I found that harrowing the land after ploughing, then running a spading-harrow over the land, and finally working it up again with a cultivator, and then sowing, repaid the outlay several times over.

Rolling and harrowing after the crop is up is often beneficial, but this must be left to the farmer's own judgment, as so much depends upon the land and the season.

For hay about 1½ bushel of seed per acre is required; for grain a less quantity is best, about 1 bushel being ample.

For hay-making see p. 124.

MAIZE.

J. L. THOMPSON.

THE most suitable soil for maize is sandy loam, such as is found on alluvial flats by the banks of rivers; and the loams that are formed by the disintegration of volcanic rocks. The districts in which it grows well can be seen on reference to chapter on Land Board Districts, p. 6.

[Maize is not grown to any extent in the Western District, except in specially favoured spots where the soil is rich and the rainfall fairly good. In an average season in the Riverina, sorghum would give twice as much fodder as maize, and therefore as a fodder crop maize is not considered a success. The yield of grain, too, in most seasons is very small, and therefore it does not pay to grow except for consumption on the farm.—ED.]

Preparation of the Land for Maize.

Land intended for maize should be deeply ploughed, say from 7 to 9 inches, according to the nature of the soil. A perfect tilth must be obtained by harrowing, scarifying, discing, or rolling; the better the tilth the greater will be the returns. The maize roots penetrate to a considerable depth, and a deep tilth should, therefore, be provided at any cost.

With some of the corn-cultivators available the cultivation of the corn can be started without delay, and continued throughout its growth until the plants are 3 feet high. The use of such implements early and frequently will entirely prevent the growth of weeds after the corn shows above the ground, besides which the entire surface of the soil is kept thoroughly pulverised. This forms an impervious mulch, which is of inestimable value in a dry season, and the land is left in the most perfect condition for rapid plant growth and early maturity. The weeds are killed without injuring the tender roots of the growing corn, hence the crops are given a good start. The machines can be adjusted to any angle and set so as to throw the soil either to or from the row as desired, whilst the width can be altered to suit the work that is being done. Another feature about these implements is that they can be adjusted to cut deep in the centre and shallow next to the row, or the reverse, and owing to the construction of the arched frame in the implement used at the College farm, the corn can be straddled until it is 3 feet high.

Time of Planting: Influence of Early and Late Sowing upon the Yield.

Experiments have been conducted to test how far the yield was influenced by early and late sowing. I am of opinion that considerable range in the time of sowing can safely be relied upon for success with this crop, all other conditions being favourable. Sometimes seed sown in September gives the best results, while again seed sown as late as Christmas will produce the best crop. The results depend entirely on the season. Maize does not like a check in growth, either from excessive moisture or severe drought, the critical period being when it is tasselling. The following results do not show very much variation:—

	Bushels.	lb.			Bushels.	lb.	
27th September ...	49	24	per acre.	8th November ...	48	23	per acre.
11th October ...	45	0	„	15th „ ...	54	32	„
18th „ ...	32	48	„	22nd „ ...	60	0	„
25th „ ...	52	29	„	29th „ ...	60	0	„
1st November ...	51	3	„	6th December ...	39	34	„

These experiments depend greatly upon the weather at the time of sowing, and more particularly at period of tasselling.

Some excellent crops have been produced from early sowing, others have proved comparative failures, and *vice versâ;* it all depends on the season. It is safest to commence sowing in September, and continue at intervals until December. By this means a greater chance is obtained of getting a better all-round average crop.

Varieties to Grow.

The following are the names and leading characteristics of twenty-three varieties of maize grown for several years on the Hawkesbury College Farm.

Name of Variety.	Leading Characteristics.
American White Meal Maize	Yield good; would do well for maize-meal or cooking; large grain, rather pinched.
Early White Pop Maize	A small white maize, suitable for poultry; a very early corn.
Small Hard Red-pith Maize	Grain rather small; cobs small and plentiful.
Red Hogan Spindle Maize	Large red corn; well formed, heavy grain; well adapted to this district.
Improved American Ensilage	A soft white corn; very good for ensilage or green feed.
Red Pop Maize	A small red corn, suitable only for poultry; a good yielder.
Pitted Red-pith Maize	A yellow corn; medium size grain; a good profitable corn.
Large Yellow Flint Maize	Large round-grain yellow corn; heavy yielder; small pith; well adapted to this district.
Early Yellow Pop Maize	A small yellow maize; very early; suitable for poultry,
Small Red-pith Maize	Small, bright, yellow corn; an early producer.
Ninety-day Maize	Medium size bright yellow corn; very hardy and early.
Hogan Maize	Large, yellow, deep grain; very hardy; small pith; a good marketable corn.
Early French Maize	Small, yellow corn; large pith; an early variety; suitable for poultry.
Abercrombie Maize	Small, yellow corn; very deep green; early variety; very small pith; suitable for poultry.
Ninety-day Maize (large variety)	Large, yellow, long cobs; fair yielder; very hardy and early.
College Hybrid Maize	White hybrid; good for ensilage.
Red-pith Maize	Large yellow grain; fairly hardy; large red pith.
Pitted Red Hogan Spindle	Large dark-red corn; big cobs; large pith; good yielder.
Late White Pop Maize	Small white corn; late variety; fair yielder; very small, and fit for poultry.
American Edible Maize	Large, white, soft maize; suitable for table or ensilage; well adapted to this district.
Golden Drop Maize	Bright, yellow, medium-size corn; soft, large, white pith; good yielder.
Variety of Hard Red-pith Maize	A mixed variety; small hard corn.
Horse-tooth Maize	Soft, white maize; suitable for ensilage; grain marked on top like a horse's tooth.

As is well known, when a number of varieties of maize are grown on the same farm it is difficult to prevent cross-fertilisation by bees. As an instance of this, I may mention that on visiting a National Prize farm some time ago on the Clarence River, the proprietor showed me some cobs comprising nearly all the colours known in maize, and he informed me that some few years since he had twenty-six distinct varieties of maize, but owing to cross-fertilisation he could now produce the twenty-six on one cob. I have known maize plants to become crossed when growing a mile apart, and this being so, it is most difficult to prevent crossing. It is best to find out by experiment what varieties are best suited to certain soils and climates, and for farmers to stick to two or three kinds only. The favourite varieties on the Hawkesbury are Red and Yellow Hogan, Red Spindle, Red-pith maize, Abercrombie, and Ninety-day.

Some of the white varieties give great yields, but they have never realised the same price in the markets of the world as yellow or red varieties. White maize as a rule gives the best return as fodder for milch cows, or for making into ensilage, as the plant is generally more vigorous, and produces more stalks and leaves. The flint varieties are said to make the best meal.

Selection and Preparation of the Seed.

The seed should be carefully selected, and soaked in a solution of sulphate of copper (say, 1 lb. of bluestone to 10 gallons of water) in order to destroy the spores of smut; and to prevent birds and animals from scratching up and devouring the seed. It is a good plan to give it a coating of coal tar; half a pint will suffice for a bushel. Mix with a little warm water, and when cold pour on gently and stir with a stick until the seed is coated all over.

Planting.

There are many ways of planting, but experiments extending over many years have proved that the best results are obtained by dropping single grains of good seed 16 inches apart in drills 4 feet wide. It has been found at the College Farm that any deviation from this, whether in the direction of increased or diminished seeding, invariably results in diminished yield. About a peck of seed will sow an acre in this way.

The "Lister" is a machine specially designed for putting maize in during dry weather, or in a dry district, so as to ensure germination of the seed. It is extensively used in the drier prairie States of America. The "Lister" is a double mould-board plough, which turns the soil right and left. A subsoil attachment loosens the soil and subsoil to a depth of 18 inches. The seed is dropped into the fresh, moist earth, and is immediately covered by the wings of the subsoilers. A concave wheel follows, pressing the earth down upon the seed, thus retaining moisture.

According to Professor Shelton the advantages of the listing method are:—

1. Listed corn, having its roots in the deeper under soil, is not so much affected by drought as that which is surface-planted.
2. The cost of growing the crop is reduced one-fourth to one-third.
3. The listed field gives a larger yield than that obtained by the common methods of planting. The Hon. J. L. Dow, when Minister of Agriculture in Victoria, obtained a listing machine from America for the Dookie Agricultural College farm, and by its use we were able to grow fair crops of maize in that dry region when without it this would have been almost impossible. It should be explained that the word "listing" is an Americanism for ridging.

Depth to Plant.

Provided the soil is moist the nearer the seed is sown to the surface, say covered 1 inch, the more rapidly will it sprout; while this shallow planting produces a stronger stalk and better crop than seed planted at greater depths.

For planting in dry districts, the "Lister" and drill method of planting has proved most successful.

The Treatment of Maize after Sowing.

The success of the maize crop depends to a very great extent on the amount of after-cultivation bestowed upon it. The first operation practised here after planting is to harrow the ground once before the plant appears above ground, and sometimes twice afterwards before work is commenced between the rows with the disc cultivators or Planet Junior hoes. The harrowing at so early a stage destroys all weed growth close up to the plants, and is a great saving of after-labour in keeping the land clean. In order to show the value of thorough cultivation of the soil during the growth of the plant, I give the results of experiments at the College. They are interesting and highly educational.

Plot.		Bushels	lb.
1. Uncultivated	Yielded	35	22
2. Cultivated once	„	38	50
3. Cultivated twice	„	41	37
4. Cultivated three times	„	60	41
5. Cultivated four times	„	61	42

It is generally recognised that it is an advantage to hill maize, but few farmers have tried the experiment in order to compare results. It has been proved in America, however, that hilling does more harm than good, as it seriously lacerates the surface fibrous roots, and undoubtedly checks the growth of the plant. The only good hilling might do is to prevent the stalks from blowing over in exposed situations. Our experiments in this direction gave the following results:—

Plot.		Bushels	lb.
1. Grown on the flat principle	Yielded	55	33
2. Hilled up		53	55

Other treatment in both cases precisely similar.

Manipulation of the Growing Crop.

Numerous experiments have been carried out in America and elsewhere for determining the effect of removing the tassel or upper part of the female flowers from the cobs as fast as they appeared; of the removal of the lateral shoots or suckers; and the topping or removing all the portions of the stalk above the cobs or ears. American results: The removal of the tassels proved a decided injury to the crop, which yielded 5½ bushels less than untouched maize yielded. The removal of the lateral shoots also proved detrimental to the crop to the extent of 5 bushels per acre. Topping also resulted in a loss of grain, both in quantity and quality.

Our experiments at the College Farm proved the same. Here they are—

Plot.		Bushels	lb.	
1. Tasselled	Yielded	53	6	per acre.
2. Topped	„	34	51	„
3. Suckered	„	41	37	„
4. Untouched...	„	55	33	„

Harvesting and Husking the Maize Crop.

The harvesting and husking of maize by hand is a tedious labour, but there is up to the present no machine that can perform this work satisfactorily. An expert husker can manipulate about 100 cobs in five minutes.

Storing.

Drying Cribs for Maize.

There is no farm crop known to me that will stand with impunity wind and rain after it is ripe better than the maize crop. The other cereals, such as wheat, barley, and oats, must be quickly harvested as soon as ripe, but the maize cob may hang for an indefinite period without deterioration. The cob, although upright when in a growing condition, bends over as it becomes ripe, and when deep ripe it hangs almost perpendicularly down; the husks act as a perfect thatch, and if floods are not feared the work of harvesting may be done at leisure.

If the stalks are not required for ensilage and floods are not feared, it is better to allow the cobs to get thoroughly dry and ripe before harvesting. The drier the cobs the easier they are pulled off and husked, whilst they can then be put away in greater bulk with safety.

The cob-cribs on the farm are above the cart, implement, and machinery sheds, and answer admirably. I got the idea at Mrs. Onslow's fine farmsteading, at Camden Park. It is not necessary to have lofty buildings for carts and implements, and in any ordinary case there is ample room for a loft or crib for maize. The sides of cribs should be trellised or latticed to allow access of plenty of air. A batten floor should in some portion be provided for drying cobs, but care must be taken not to put the battens too wide apart, otherwise the corn, as it becomes shelled, will fall through and be wasted if a few fowls are not about to pick it up. One-eighth inch between each batten is wide enough apart.

Capacity of Bins.

As a rule (or on an average) 2 bushels of cobs make a bushel of shelled corn, or, in other words, 75 lb. of corn in the cob is equal to a bushel of 56 lb. weight of shelled corn.

A cubic foot contains 1,728 cubic inches, and the Imperial bushel 2,218 cubic inches. This is the recognised measure throughout the British dominions. There is, of course, a vast difference in the yield of the different varieties of maize, and in order to arrive at the dimensions required for holding a certain crop yielding so many bushels to the acre, it is best to reduce the contents of the crib to bushels.

Cost of Producing an Acre of Maize on the Hawkesbury.

I have had numerous consultations with experienced maize-growers in this district, and from the result of our operations on the farm I give the cost of producing an acre as follows:—

	£	s.	d.
First ploughing—8 inches deep ...	0	9	0
Second ploughing ...	0	6	0
Discing twice	0	2	0
Harrowing three times	0	1	6
Rolling	0	0	6
Striking out	0	2	0
Sowing with drill ...	0	2	0
*Manure	1	10	0
Seed and pickling with bluestone	0	0	6
Harrowing young crop twice	0	1	0
Discing growing crop four times	0	6	0
Pulling and carting	0	5	0
Husking 60 bushels	0	6	6
Thrashing or shelling	0	5	0
Bagging and marketing	0	5	0
Total	£4	2	0

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* This is an expenditure that would scarcely ever be necessary on the soils usually chosen for maize. College soil is poor.

Maize Cobs as Food for Stock.

A great deal has appeared in the American Agricultural Reports and newspapers as to maize cob pith being of considerable value when ground as food for stock; it is even said to be equal in nutritious value to wheaten bran. Manufacturers soon devised an ingenious machine that successfully grinds the cob to powder; one of these has been procured for the College Farm. I was anxious to try the experiment fully, as the results can only be accurately judged after a considerable period of actual feeding. I have now been feeding our working horses for over two years on the cobs and pith ground up together, with most excellent results. No thrashing is required, which is a great saving.

The machine used for the purpose only costs £12, and can be drawn by one good horse or two light ones.

Maize is too concentrated a food by itself, whilst grinding the pith up with it improves it very considerably. I had some of the maize cob pith analysed by Mr. Guthrie, and compared with other analyses. The following are the figures:—

"I append analyses of wheaten bran (after Warrington), an American sample of maize (after H. W. Wiley), and maize cob pith from our own farm (Departmental Analyst, Mr. F. B. Guthrie). A perusal of the figures will indicate the relative value of cob as compared with the kernel and with wheaten bran.

	Wheaten bran.	American.		H. A. C. Maize Cob Pith.
		Cob.	Kernel.	
Water	14·0	9·33	10·49	13·575
Nitrogenous substances	14·5	....	....	....
Fat	4·0	·47	5·49	·595
Carbo-hydrates	51·3	56·01	69·72	44·471
Fibre	10·1	30·36	2·13	35·311
Ash	6·1	1·33	1·55	1·597
Albuminoids	....	2·50	10·62	4·451†
	100·00*	100·00	100·00	100·000‡

* Contains albuminoids = 11·7 † Nitrogen = ·712.

‡ The ash contained :—Silica, 20·476 ; lime, ·817 ; P_2O_5, 4·859 ; magnesia, 1·753 ; potash, 24·360.

"The feeding value is fair, being about 50. The ratio between albuminoids and carbo-hydrates being 1 to 10⅓. The addition of maize would improve its value as a food considerably.

"The manurial value of the cob is very low, and it would not greatly increase the value of the resulting manure if fed, as suggested, to pigs. (Guthrie.)"

I cannot too strongly recommend the use of a machine that will grind to powder the whole cob, as the product will be found to be more suitable as food for all kinds of live stock. The Americans have now in use a machine that tears to pieces the husk, cob pith, and all, thus dispensing with the great labour of husking, the whole making very palatable and nutritious food, and saving a great deal of labour.

Maize as Food for Milch Cows.

Either as a green succulent fodder fresh from the field, or made into ensilage, Indian corn cannot be excelled as a most suitable food for milch cows, and it is quite possible to harvest 50 or 60 bushels of corn to the acre, and also save the stalks in a succulent condition as ensilage. This system is now carried on extensively in America, and since 1895 has been practised at the College Farm.

When the cobs are just matured, and before the stalks have dried up at all, they should be picked, husked at once, and thrown into a dray or waggon, and immediately carted to the corn-crib, if possible an elevated battened floor, where they should be spread thinly all over. The stalks should be at once cut and carted to the silo, passed through a chaff-cutter, and pressed, when they will be found to turn out ensilage as good as could be desired. The stalks are then at their best as food for stock, and, in fact, our ensilage this year from the stalks only was superior to that cut in a more succulent condition. I therefore see nothing to prevent anyone from harvesting 50 or 60 bushels of good marketable grain, and obtaining 10 or 15 tons of first-class ensilage per acre as well. The variety operated upon with us was the ninety-day corn, but any sort will do equally as well. It is true the cobs shrivelled a little, but the depreciation in value is not very great.

In any experiments conducted here, corn fodder has always proved much superior to sorghum for milk production. Maize, even for green fodder, should not be planted broadcast, but in drills at such a distance apart as will admit of convenient cultivation. When too thickly planted the stalks are bleached and slender, the leaves are pale, and lacking in vigour and deficient in nutritive materials. Being a semi-tropical plant, with its wealth of foliage, it requires an abundance of light and air for its vigorous growth and development. When the stalks are crowded in dense masses, as when sown broadcast, the upper leaves only receive light to enable them to carry on the active assimilation of carbon. I recommend the drills to be 3 feet apart, and a seed dropped every 9 inches. Immense quantities of maize-hay are now made every year in the American States.

Maize under Irrigation.

The maize plant requires a large quantity of moisture for its full growth and highest development, and there are few places in this Colony where the yield could not be increased by a system of irrigation, for, although sufficient rain falls during the year, its fall is irregular, and it does not come at the right time. I am convinced that an application of from 4 to 6 inches in two waterings during the critical period of growth in this district would increase the yield one-half. The capabilities of maize production on the river flats of the arid portions of the western portions of this Colony are simply immense. I have seen most excellent crops of maize under irrigation at Messrs. N. A. Gatenby & Co.'s farm, Jemalong, near Forbes (awarded the National Prize for the best irrigated farm in 1891). D. Cormack grew 80 bushels to the acre in the very dry climate of the Murray River by means of irrigation. In India and Egypt large areas of maize are raised under irrigation, as is also the case in some of the dry regions of America, viz., Colorado, New Mexico, and California. In applying water it is best to run it in the centre between the rows, so as to encourage the roots to strike out in search of it. Cultivation should always follow a watering.

MAIZE FOR THE TABLE.

N. A. COBB.

Varieties.

The flint varieties make the best meal, flour, and starch. A Yankee housewife will never take "Indian meal"—that is, maize-meal—made from what she calls "western corn"—that is, corn of the dent variety—if she can get that made from what she calls "Indian corn"—that is, corn of the flint variety. Of sweet corn, for cooking when green, there are early and late varieties. The early varieties are small, some of them dwarf. The variety known as the "Cory" is very early and fairly good in flavour. The "Blue Mexican" is an excellent early sort—unusually sweet and tender. Of the late varieties, "Stowell's evergreen" is the best. The ears are large and sixteen-rowed. The "Mammoth" is another good late variety. The flint varieties make the best hulled corn. Of pop-corn the rice-corn varieties are among the best, of which the white and red are about equally good. The only kind better than the rice-corn is the golden dwarf variety, which is exceedingly tender when popped. Unfortunately this variety is a poor yielder.

Pop-corn.

How to cure.—Most people know what popped corn is—that is, they have heard of it, or seen it, or tasted the miserable travesty sold in paper bags; but few people outside of America, I imagine, know the delicate flavour of the article when fresh and properly prepared. Popping corn is an art, and if not a high art it is at least an art that lays claim to beauties peculiarly its own. I well remember a pop-corn bazaar at the Centennial Exhibition at Philadelphia, 1876, which was at once the wonder and delight of foreign visitors. Here might be seen the wonderful—to the novice at least—operation of popping corn. A mere handful of common-looking kernels thrown into a hopper was converted in a moment's time, amidst much popping and crackling, into a marvellously great quantity of snow-white, crisp and delicious popped corn. Few came to that bazaar without remaining to invest, and few went away dissatisfied. Corn to pop well must be of a certain kind, and in a certain condition. The kinds are known as pop-corn, and have been already mentioned. The condition is not so easily described. In the first place, it is to be borne in mind that the kernels of pop-corn have a stronger and thicker outside skin than do the kernels of other sorts. When a kernel of corn is heated over a fire the moisture in it is gradually converted into steam, and the steam tending to occupy a much greater space than the moisture from which it originated tends to burst the kernel open. Of course, the stronger the skin or "hull" of the kernel is, the more difficult it will be for the steam to burst the kernel open, and the greater will be the final explosion. In good pop-corn, properly popped, the explosion converts the kernel into a white fluffy mass of starch and gluten, often twenty times as large as the original kernel. At the same time the hull or skin is thrown off, if the variety is a good one, so that nothing tough remains to mar the pleasure of eating. Even ordinary flint maize will pop, but only indifferently. Its hull offers very little resistance, and consequently the explosion occurs before there is much pressure generated. The result is that the kernels are split only on one side, and when popped are little else than parched; but if one has good teeth they are by no means bad eating.

After what has been said concerning the manner in which corn "pops," the reader will not be surprised to learn that the art of preparing it begins in the field. Pop-corn must be well ripened and then cured. The curing consists in storing the ears in a cool dry place until the kernels have become right for popping. The time varies from six months to twelve, according to the kind of corn and the place in which it is stored. When pop-corn is fresh from the field it contains too much moisture to pop, and the outside skin or hull is too weak. When heated it pops prematurely with a slight crack along the side of the kernel, so that the popped kernels differ very little from the unpopped ones in size. During the curing, two changes take place: first, the kernels become drier, and second, the hull becomes tougher. When right for popping, each kernel will contain enough moisture to generate steam under the influence of a fire, and the hull will have become tough enough to resist the steam until a good pressure is generated. From this it will be seen that too long a curing will be injurious. When the kernels become so dry as to contain little or no moisture, nothing will make them pop. Such corn can be renewed by judiciously placing it in a rather damp store-room.

How to pop.—It is half the battle to have the corn properly cured, but not more than half; the popping is the other half. If the corn is properly cured, the popping is bound to be some sort of a success; but to attain the best success a little practice is necessary. It is a delicate operation, in which a few seconds make all the difference. Have a hot fire. If the fire is in a stove, have the lids so hot that they gleam in the dark. This is the best heat of all, and secures good results with the utmost certainty. If such a heat cannot be obtained, the corn may be popped directly over coals. Never put too much corn into the popper at once. The popper is a hopper made of wire-netting (corn-proof), and having a wooden handle about a yard long, attached *à la* dipper.

Corn Popper.

Barely cover the bottom of the popper with kernels, and then close the lid and fasten it so securely that the popper may be turned upside down with impunity. Now warm the corn at some distance from the stove or coals, keeping it always in motion by shaking the popper back and forth, until the first kernels are heard to pop; then lower the popper as near the coals as possible, and shake vigorously until all are popped. It is a lively time. There is nothing morose about pop-corn. How it snaps! It is enough to carry the old soldier back to war times. It starts reminiscences. You are in for a night of it—but you must look out that it does not burn; keep it shaking! After the last kernels have ceased popping, raise the popper a bit, and roast the popped mass a minute or two, turning all sides to the fire. Be careful that it does not scorch or catch on fire. It will burn like tinder.

Now it is done. Open the popper lid and pour into a tin basin; salt it, or butter it and then salt it, and put it before your guest within five minutes. He will thank you, especially if his only previous acquaintance with pop-corn has been through the medium of the man who sells it in paper bags.

Butter should be supplied in small quantities. Melt a piece half the size of a small walnut in a large dish and pour the popped corn on it, and stir it a moment while hot. Serve the corn in another warm dish. Butter all the corn in same dish, adding butter and melting it as required.

It is surprising how much popped corn a man can eat. A peck is a moderate allowance. Most people get modest before they have eaten all they would really like. A good sized handful of kernels makes a peck when popped. Popped-corn is very easily digested, and children may have an unlimited supply of it. They love it dearly (of course I do not refer to that sold by the paper-bag man). Popped-corn is often eaten in milk. It is a dish well suited to children and persons of weak digestion.

It is well worth noting that popped-corn furnished the idea for the preparation of corn starch or flour on an extensive commercial scale. Corn starch is now prepared by saturating corn with superheated steam under pressure in iron cylinders. When the proper pressure is reached the end of the cylinder is suddenly knocked off, and the whole mass instantly explodes into the finest starch imaginable.

Popped-corn, it must be remembered, is a winter luxury in America, and is not so much thought of in summer. Many a long winter's evening is sweetened by its presence among the high as well as low, but it is at the farmer's fireside that it is seen at its best.

It is long since dark, and the "chores" are done. Father sits before the fire deciphering the political situation by the aid of the local paper; mother is knitting stockings. Some one is inspired with the thought of popped-corn.

The corn is stored up-stairs out in the long wood-house. It is freezing cold; and it makes the cold-shivers run down the backs of the girls to think of going for it. Susan thinks Mary ought to go. Mary thinks Susan ought to go. They both think Tommy ought to go—he knows best which to bring. Tommy being the youngest, of course has to go; but he has the satisfaction of having Mary sent along with him "to see that he does not set the house on fire with the light." The corn shelled, the popper is got down from the top shelf in the pantry, and then there is a bustle to "see which fire is the best." This momentous question settled, it is not long before the first shot is heard along the skirmish line, followed by a rattling volley—from the popper. A delicate aroma steals through the house, and about this time father awakes to the situation, and is ready for the nonce to let politics go to the dogs, and drown his fear of the country being wrecked generally, in a plate of popped-corn. It is grand. The memory of it is worth thousands of pounds in after life.

What would the American Christmas be without popped corn? It is matchless for festooning Christmas-trees, and is universally employed in various ways. Strung on threads by dainty fingers, it is used in yards upon yards, and forms snow-white delicate festoons which contrast beautifully with the green of the spruce tree and the light of the candles. At all church Christmas festivals bags of lollies are hung on the trees, one for each child, judiciously diluted with fresh popped corn—a bit of economy; it makes the lollies go further, and besides it is better for the children.

Pop-corn cakes and pop-corn balls.—These are the accompaniments of the Yankee candy-pull. A candy-pull is an evening party whose ostensible object is to transform New Orleans or Porto Rico molasses (treacle) into candy (lollies), a process which it is not necessary to describe here, and then to make away with the same; but which is in reality designed to bring people together in social intercourse. Popped-corn can be made to adhere in balls or cakes by the application of a very small amount of hot, well cooked molasses. The combination is a very pleasant one. The process is carried out on a commercial scale by many confectioners. Carefully assorted popped-corn, coarsely pulverised and freed of all hard parts, is cemented into cakes 2 inches by 2 inches, and half an inch thick by means of cooked molasses, and put on the market in tins like those used for biscuits. It is one of the best confections made.

There are two other ways of popping corn that deserve mention: Have a saucepan of boiling hot fat and drop the kernels, a few at a time, into the fat. They sink but soon pop and come to the top, and are then taken off immediately with a skimmer and salted. This does very well in cold climates where appetites are sharp, but the result is a little too greasy to be appetising under other circumstances. Finally, corn may be popped in hot ashes. Have a bed of new hot ashes and a clean hearth. Throw the kernels into the ashes and they will soon pop out on to the hearth surprisingly clean.

"The little boy gathered them into a heap,
And called them his flock of milk white sheep."

Sweet Corn—"Colonial Sugar Maize."

How to tell when ready for use.—Sweet-corn is ready for use when the kernels are full grown, but before it has begun to harden in ripening—while it is in the stage known as "in the milk"; that is, while the kernels, if punctured, yield a milky juice. A little experience is necessary to judge of the fitness of the ear by its external appearance. The silk should be brown and somewhat dry, and the ear should feel firm and well filled. As opinions differ as to just when the corn is most toothsome, it does not matter if a mess contains ears of varying conditions. At any time will be found some who prefer the younger stages, and others who prefer the older stages.

How to prepare for cooking.—Remove all the husks and every particle of silk. An ear of boiled corn with bits of silk adhering here and there, has as untidy an appearance as a boiled potato with bits of peel left in the eyes. Cut off the stalks close to the cob, both for appearance sake and to save room in the saucepan.

Boiled sweet-corn.—Drop the prepared ears into a saucepan of boiling water and boil twenty minutes. If the corn is a little too hard or old—that is, too fully grown—a little longer time is necessary, but never more than thirty minutes. Servo as taken from the saucepan; eat with butter and salt. Each person butters and salts his own ear. Good either hot or cold. If you wish to eat the corn *à la Yankee*, take one end of the cob in one hand and the other end in the other hand and gnaw the kernels from the cob—two or three rows at a time. It sounds barbarous, and looks more so, if you are not used to it. I can imagine the feelings of an Englishman on first watching a Yankee eat his ear of corn. He would probably prefer to call it a species of devouring. There is everything in the bringing up, however; and thus it comes about that people of one nation often do as a matter of course what seems, to say the least, rude, to those of another nation. Another way of eating boiled corn is to remove the kernels from the cob with a sharp knife, used tangentially. The kernels are then eaten with butter and salt.

The amount of boiled sweet-corn consumed in America is enormous. Many families consume from two to three dozen ears daily throughout the season, which lasts two months, its termination being regretted by all. In New South Wales the season can be prolonged to six or even seven months by planting every fortnight, beginning in August.

A nice breakfast dish is made from the cold boiled corn. With a sharp knife cut the kernels from the cobs, and simmer for a few minutes in enough milk to cover. Season with butter and salt.

Green corn fritters.—Select ears that are a little too old for boiling. No. 1. Grate the corn from twelve raw ears (using bread-grater). Into the grated corn stir two tablespoonfuls of flour, one beaten egg, one teaspoonful salt, a little pepper. Drop the mixture by spoonfuls (one spoonful for a fritter) into a hot, well-greased frying-pan; fry like pancakes. To be eaten with butter and salt. No. 2. To each cupful of grated corn allow one egg, one tablespoonful milk, one dessertspoonful melted better, one dessertspoonful flour, one-half teaspoonful salt. Fry and serve like No. 1. Either of these is a dish fit to set before a king, even if he were to entertain another king.

Green corn soup.—Grate the corn as for fritters. For six medium-sized ears use one quart boiling water, and one pint milk. Boil the cobs (after removing the corn) in the water ten minutes. Remove the cobs, and to the water add the grated corn and milk, then butter, salt, and pepper to taste.

Succotash.—This is a dish of Indian origin. The name was adopted by the New England Puritans from the Narraganset Indians, whose dish insickquatash was corn boiled whole.

> "The wise Huron is welcome; he has come to eat his succotash with his brothers of the lakes."—*Cooper.*

The corn is boiled, then cut from the cob and mixed with an equal quantity of green beans shelled and boiled, and seasoned with butter and salt, and, if liked, a few spoonfuls of cream or milk are added.

Roasted green corn.—For roasting, corn should be of the same age as for boiling—that is, in the milk. The ears are to be stripped completely of their husks and thrown on a lively bed of coals and occasionally turned. No matter if they burn a little, the flavour is not injured—in fact, many think it improved. If the ears are a little soiled with ashes there is the comfort of knowing there is nothing unwholesome about that. If dainty, one may impale the ears on a long-handled fork, and hold them close to the coals, but will gradually abandon this process for the more direct one of roasting on the coals. When roasted the ears are buttered and salted, and then eaten hot, best direct from the cob. In order to impart to roast corn its most delicate flavour it is necessary that it should be purloined from some farmer's great field under the cover of darkness and then roasted by an open bonfire in some secluded spot. It is also necessary to be a boy—or an unusual sort of a girl.

For winter use.—Sweet corn is prepared for winter use by canning and by drying. The canning is done almost entirely at factories. While canned sweet corn forms a very acceptable article of food, it is entirely different from the fresh corn and far inferior to it.

For drying, corn is selected that is a little too hard for boiling. The ears are scalded (not boiled) and the kernels then cut from the cob and spread on cloth in the sunshine to dry. As the corn must be thoroughly dry, the process is finished in a warm oven in shallow pans. If the kernels become somewhat brown and slightly scorched the flavour is not injured.

To cook dried corn.—Wash and soak overnight. In the morning add more water if necessary (just enough to well cover the corn) and *simmer* several hours. Do not allow it to boil hard. The water should nearly all simmer away. None should be turned off, as it contains considerable sweetness from the corn. A few minutes before serving add milk enough to just cover the corn, and season with butter and salt.

Common maize or Indian corn may be boiled when "in the milk" and served like sweet corn, but is greatly inferior to it.

Hulled Corn.

In New England—that is, the north-eastern part of the United States—hulled corn is a favourite winter dish. The corn (ripe flint corn) is hulled by long-continued boiling, at first in a very weak solution of alkali (soda or potash being used), afterwards in clear water. The operation takes all day, and the water is changed three or four times. When taken from the last water, salt enough to make it palatable is stirred into it. The hulled corn is eaten hot or cold with milk, cream, or treacle.

Samp or hominy is made by boiling cracked corn till tender, without alkali. It is allowed to cool in a mould, then served cold with milk or cream or fried in slices and eaten with treacle.

Maize Meal, or Indian Meal.

In its ripe state maize is not to be despised as an article of food, and forms the basis of many toothsome dishes. Unfortunately, it is very difficult in New South Wales to obtain really good maize or maize meal. I know of no other explanation of this fact than that, because of its very limited use as a food staple, not much care is used in storing and keeping it; and of all the grains it is the one most likely to become musty.

The raw maize meal to be used in cookery should have a fresh sweet taste, impossible to describe, but readily learned by a little practice. If a poor quality of maize is used, disappointment will be sure to follow.

Plain Indian cake or Johnny-cake.—The name Johnny-cake is evidently a corruption of "journey-cake," as in Colonial times, in America, people travelling started with a good supply of this bread for the journey.

One pint of sour milk, one teaspoonful soda, one teaspoonful salt, a little sugar or treacle. Mix to a stiff batter with maize meal. Bake in shallow pans in a very hot oven. Eaten either hot or cold with butter or in milk. Still nicer if baked in the form of small gems in the *iron* roll-pans, which are heated piping hot before dropping the batter into them. Baked on a hoe or shovel or even a board before the fire this same Johnny-cake becomes the hoe-cake of the southern negro.

Indian breakfast cake.—One cup maize meal, one cup wheat flour, one-half cup sugar, one cup sour milk, one egg, one teaspoonful soda. Bake in a shallow baking tin. To be eaten hot with butter.

Spider corn-cake (Miss Parloa).—A frying-pan is termed a "spider" in America. One and two-thirds cups maize meal, one-third cup wheat flour, two eggs, one cup sour milk, two cups sweet milk, one small teaspoonful soda dissolved in sour milk, one-fourth cup sugar, one teaspoonful salt. Mix salt, sugar, flour, and meal together. Beat the eggs very light; then add one cup of the sweet milk and the sour milk and the eggs to the flour and meal. Put a piece of butter one half the size of an egg into the hot frying-pan. Pour the mixture in, then add the other cup of milk, but *do not stir* it in. Bake one half hour in a very hot oven.

Corn-cakes (Miss Parloa).—Three teacupfuls maize meal, one table-spoonful sugar, one teaspoonful salt, one tablespoonful butter, one egg, one and one-half pint boiling water. Add the sugar, salt, and butter to the meal, pour on the boiling water, and stir together. Add the egg, and beat thoroughly. Spread on buttered tins very thin. Bake one half hour in very quick oven. Should be one-fourth of an inch thick when baked.

Hasty-pudding.—This is made in much the same manner as oatmeal porridge, using maize meal instead of oatmeal. Boil slowly (taking care not to burn, as maize burns very readily) one half hour. To be eaten hot with butter and treacle, or with milk either hot or cold. A nice breakfast dish is made by cutting the cold pudding into slices and frying. To be eaten with treacle or gravy.

Corn-flour.

Plain Corn-flour pudding.—One quart of milk, six tablespoonfuls corn-flour, one teaspoonful salt. Let the milk boil, then stir in the corn-flour which has been mixed with one-half cupful of cold milk. Add the salt. Boil ten minutes. Serve hot, with milk and sugar, or butter and sugar.

Snow-pudding.—One quart of boiling water or milk (or half of each). Four heaping tablespoonfuls of corn-flour. White of three eggs. Mix the corn-flour with a little cold water, and stir into the boiling water or milk. Then add the well beaten white of eggs and a little salt. Stir lightly, and set in a mould to cool. Serve with custard made with one pint of milk, yolks of three eggs, one-half cup of sugar. Flavour to taste.

Delmonico pudding.—One pint milk, yolks of three eggs, one-half cup sugar, three tablespoonfuls corn-flour. Scald the milk, add the sugar, then the beaten yolks, then the corn-flour, previously wet, and a little salt. Pour into a baking dish and set to cool. When cold, spread over the top, fruit, jelly, jam, or canned-peaches. Beat the whites to a stiff froth, and stir in lightly one tablespoonful sugar, and spread this mixture lightly over the fruit. Brown delicately in a hot oven. Serve cold.

Floating island.—Scald one pint of milk. Stir together the beaten yolks of two eggs, three tablespoonfuls of sugar, one tablespoonful of corn-flour (previously wet with a little cold milk) and add to the hot milk. Flavour with lemon. Pour into the dish from which it is to be served. Boil some water in a frying-pan. Beat the whites of the two eggs to a stiff froth, and drop this by spoonfuls into the boiling water. Let it remain a few seconds, then skim out and lay around on the float. Serve cold.

Chocolate cream.—To one quart of scalded milk add five tablespoonfuls of grated chocolate, three tablespoonfuls of corn-flour (previously wet), and three-fourths cup of sugar. Flavour with vanilla. Serve cold with whipped cream.

Lemon custard tart.—Line a baking plate with paste rolled very thin, and make a raised edge of paste. Fill with the following mixture:—Yolks of three eggs, one cup of sugar, one cup of milk, one tablespoonful of corn-flour, juice of one lemon. Beat the yolks, add the sugar, then the corn-flour wet in the milk, then the lemon juice. Pour into the paste-lined plate, and bake in a rather hot oven. When baked, ice with the whites beaten to a stiff froth, into which a tablespoonful of sugar has been lightly stirred. Brown slightly in the oven.

Quaker omelette (Miss Parloa).—Three eggs, one-half cup milk, one and one-half tablespoonfuls corn-flour, one teaspoonful salt, one tablespoonful butter. Beat the yolks and corn-flour together. Beat the whites very thoroughly, and stir into the mixture. Mix thoroughly, and add salt and milk. Grease a hot frying-pan with the tablespoonful of butter. Pour in the mixture, cover, and place where it will cook slowly. Cook seven minutes, then cut lightly through the middle, and turn one half over the other. Serve immediately.

Maize Bread.

What is termed brown bread in Australia is known as Graham bread in America, while the term brown bread is there used to designate various sorts of bread made from maize, rye, and wheat meal.

"*Rye 'n' Injun.*"—Made of half rye meal and half maize meal.

Thirded bread.—Maize meal, rye meal, and wheat meal, in equal proportions. Both these breads are mixed with sour or buttermilk, raised with soda, steamed three to four hours, then baked one hour. The crusts are delicious eaten in milk.

THE SURPLUS MAIZE CROP.

In the June, 1891, number of the *Gazette* there appeared, under this heading, a paragraph recommending the utilisation of the surplus maize crop for feeding pigs, pointing out that by this means farmers would obtain a very high return for their maize, and explaining that it was a safer and more satisfactory means than that of distilling whiskey. In an article which appeared in the *Town and Country Journal* of the 30th of June 1891, the latter means of utilising the surplus crop was recommended, and the Department has received a communication from Mr. J. H. Sommerlad, of Tenterfield, in which he refers to both publications, and volunteers the following opinion on the subject, which it will be admitted is one of considerable importance to farmers. Mr. Sommerlad contends that the pigs could be fed on the meal or mash which remains after the whiskey had been distilled. He says, "I had a deal of experience in Germany with schnapps distilling. We used the small potatoes, surplus of rye and barley damaged, and the refuse of wheat, for stilling. After the schnapps was extracted we fed the pigs and cattle with the mash. The schnapps would pay expenses and leave a good profit."

It was upon this decided to obtain some more detailed information on the subject, and the following report, by Mr. J. A. Despeissis, is the result of such inquiry:—

Maize for Distilling and Feeding Stock.

The European distillers pay for American maize 12 to 14 francs per 100 kilos (220 lb.). This, taking the bushel of maize at 55 lb., equals 4 bushels, and comes to from 3 francs to 3 francs 50 centimes (2s. 6d. to 3s. 4d.) per bushel.

The average chemical composition of maize is:—

Water		10·5
Albuminoids		8·4
Fat		7
Starch	63	67
Dextrine and glucose	4	
Fibre		5·2
Ash		1·9
		100·0

Thus it is seen that 67 per cent. of the constituents of maize are susceptible of being saccharified and changed into alcohol.

Theoretically, it is calculated that 100 kilos (220 lb.) of maize ought to yield 45 litres (about 40 quarts) of alcohol, at 90 degrees purity (such as is sold in commerce).

The specific gravity of alcohol being ·793 at 15 degrees C., this gives 45 x ·793 = 35·68 per cent. by weight of alcohol. In general practice, however, this possible yield should be decreased by 5·33 of the yield in volume, and in the distilling industry as much as 7·33 are allowed for saccharified substances not recovered as alcohol, giving, therefore, for 100 kilos of maize, 31 litres of absolute alcohol, or 34 litres of alcohol at 90 degrees; or again, 34 x ·793 = 24·5 per cent. of alcohol by weight. From the above data, it will be seen that in distilling:—

	Absolute alcohol.	Alcohol 90°.
100 kilos, or 4 bushels, maize, give	31 litres.	34 litres.
or 1 bushel =	7·75 litres.	8·50 litres.
1 litre = ·88 quarts, therefore 1 bushel =	6·82 quarts.	7·48 quarts.

According to late quotations, 1 hectolitre (22 gallons) of pure "grain spirit," at 90 degrees, is worth 50 to 55 francs in France. Therefore 1 litre = 50 to 55 centimes (5d. to 5½d.); 8·50 litres = 4 francs 25 centimes to 4 francs 67 centimes; and thus the distiller gets 1 franc 17 centimes to 1 franc 25 centimes per bushel of maize, out of which must be deducted cost of fermenting, distilling, and rectifying the spirit, and it is only by working on a large scale that he is able to make a fair return for the money invested. Besides this, and as an asset, should be reckoned the exhausted "mash" left in the still.

The practical value of distillery refuse as stock feed is well recognised, especially for fattening bullocks, for dairy cows, and for pigs.

The following data I have obtained at one of the largest distilleries in the world, which I had on several occasions the opportunity of visiting in connection with the special studies I was then pursuing at the Pasteur Institute, viz., "The Grain Distillery and Yeast Factory," of Messrs. Springer & Co., at Maisons-Alfort, in the neighbourhood of Paris.

The main object of that firm is the production of pure yeast, which they retail to bakers and distillers in all parts of France and Belgium. The distilled spirit, and the refuse of the still, they reckon as "profit."

The grains they use vary somewhat according to the prices ruling in the market, but consist generally of maize, $\frac{1}{3}$; rye, $\frac{1}{3}$; and malt, $\frac{1}{3}$.

The diastase in the malt promotes the saccharification of the starch in the maize and the rye, while the greater proportion of albuminoid matter and ashes, or mineral salts in the rye, supply substantial food for the "yeast."

The following is the composition of the refuse of the still:—

Nitrogenous matters	1·44
Fat	0·63
Glucose	1·10
Non-nitrogenous matters	2·30
Cellulose or fibre	2·22
Ashes	0·31
Water	92·00
	100·00

One hundred parts of the dry matter from the refuse contain:—

Nitrogenous matter	18·87
Fat	7·80
Glucose	13·58
Non-nitrogenous matter	28·66
Fibres	27·30
Ashes	3·77
	100·00

Generally speaking, the quantity of water varies from 92 to 94 per cent. It is found that an extra quantity of water is not favourable to the fattening of stock, as a great waste of animal heat is incurred in excreting part of that water. Besides, animals fed exclusively on distillery refuse contract diarrhœa.

The extra amount of water is expelled by means of centrifugal machines, or simply, as is done at Maisons-Alfort, by filling canvas-bags and heaping them up one above the other, so that a great portion of the water flows away by the pressure of the bags themselves. By this means, refuse is obtained containing 72 to 75 per cent. of water, so that it becomes possible to carry it away in bags, and the amount of dry substance reaching 25 to 28 per cent. the feeding value of the stuff is thus increased threefold at least.

100 kilos of grain give 450 litres of refuse with the above chemical composition (= 100 gallons).

1 bushel, therefore, will give 25 gallons of refuse.

1 bullock consumes 40 to 80 litres of liquid refuse per diem, or 8 gallons 3 quarts to 17 gallons 2 quarts.

1 pig consumes about 20 litres = 4 gallons 1 quart. So that 1 bushel of grain will give sufficient refuse to feed 25 pigs for one day, or one pig for twenty-five days.

Of course, this diet should be supplemented with drier and richer food, viz., in the case of cattle, straw, hay, bran, oil-cake, roots, &c.; in the case of pigs, pollard, beans, &c.

This pulp or refuse can be preserved in closed silos or barrels for some time before being fed off to stock.

Pests.

Besides the root-feeding insects such as beetles, &c., maize is subject to the attack of several varieties of cut and bolt-worms. These are the larvæ or caterpillars of a group of moths known as noctuidæ, and they often do much damage by eating off the young plants, or eating out the heads of the half-grown plants, and when the cobs are forming they will often eat into them, and destroy the forming grain. The most reasonable remedy for cut-worms is the distribution throughout infested fields of poison balls or baits.

Corn Weevils (Calandra granaria and C. oryza).—These two little beetles are responsible for a great deal of damage to corn and other stored grain; but it is chiefly in their attacks upon maize either in the field, or when stored, that farmers are interested. Both species are identical in their habits, and both are as widely distributed over the world—of the first the native land is doubtful, but the rice weevil is probably a native of India. The grain weevil has become so domesticated that, though it once had wings, from want of use they have become aborted, and now they cannot fly, and thus differ from the rice weevil which flies very well. It measures from the sixth to the eighth of an inch in length, and the general colour is chestnut brown; the head is produced into a slender snout which terminates in a mouth armed with sharp teeth, by which it gnaws a hole into the grain, in which the females deposit their eggs; but they also work their way in and feed upon the grain in the adult or beetle form, while, of course, the grubs hatched from the eggs feed upon the interior. The rice weevil is about the same size, but has the wing covers more densely punctured all over the wing cases, and shows four pale reddish-brown spots, forming a pattern upon the back. Not only do these little beetles feed and flourish in stored corn and granaries, but also find their way into the fields, and get into the cobs of the growing corn. The treatment of stored grain with bisulphide of carbon is one of the most successful methods of destroying this pest. In America they can treat 1 ton of grain for 10 cents; 1 lb. of bisulphide of carbon will destroy all the weevils in 100 bushels of corn, even in open cribs; 1 lb. will do for 1,000 cubic feet of space. Burning all rubbish and keeping corn in closed bins or clean sheds would do much to lessen their numbers and mitigate the attacks of weevils.

The Maize Moth (Heliothis armiger, Hub.)—Upon the tassel or corn silk of the late maize, a green caterpillar will be frequently found, sometimes upon every other cob on some fields. This green caterpillar develops into the well-known American boll-worm, which gnaws its way through on to the tip of the cob, eating away the grain, and forming a filthy mass with their excreta, which spreads downwards with the rain and moisture. This caterpillar varies from light green to dark brown in colour; when full grown they crawl, burrow into the soil, where they form a cell 2 or 3 inches below the surface, remaining about fourteen days in the summer-time, but much longer in the later broods. The moth is also variable in colour from an olive green to brownish tint upon the fore wings, with the lighter-coloured wings marked with blackish brown. The female lays her eggs in a very indiscriminate manner, not only on the food-plants, but anything in the vicinity, so that great numbers are destroyed while looking for food. This moth is known in America as the cotton boll-worm, from its having been first noticed upon the cotton-bolls in the Southern States, and has been known as a very serious pest for many years, but now is also just as common upon maize and tobacco. In May last, upon the Tweed River, I found 90 per cent. of the cobs in one field infested with these caterpillars, in nearly all cases in or upon the silk, where a person walking down the rows could have hand-picked them very easily. No doubt before all our native birds were exterminated they must have feasted upon these soft caterpillars, and greatly held them in check.—W. W. Froggatt, Govt. Entomologist.

For maize smut the remedy is to collect and burn any affected plants. The periodical inspection of the usual drilled crop is an easy matter.

Root Crops.

POTATOES.

Ordinary Districts.

A. A. DUNNICLIFF.

To the average settler or farmer taking up new lands, this is a crop of such importance, as providing part of the food supply of his home, or as a source of income from his fields, that he will naturally give early and particular attention to preparing for it a suitable spot.

The potato may be profitably produced in a wide range of soils, but prefers a light, rich loam, somewhat sandy, and moderately moist. These soils produce the crops of highest quality.

Large crops of excellent tubers are obtained on the alluvial flats, where drainage is good; and light sandy soils, when well manured, will frequently turn out fine yields. These light and medium soils will generally produce potatoes of good quality and quick growth; whilst the heavier soils will frequently give the largest crops,* and usually require a longer period of growth.

As a pioneer or cleaning crop the potato is specially valuable to the settler on a new farm. When taking new land into cultivation, it frequently happens from the nature of things, and the man's circumstances, that the first breaking up for cropping is a very rough affair, and the farmer asks himself "What crop can I put in this dirty, ill-prepared land, the cultivation of which will leave the soil in fit condition for any other crop, and better work?". The choice usually lies between maize and potatoes, as either of these, soil and climate being favourable, will stand a good deal of

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* As an instance illustrating this fact, I will quote just one test which came under my own observation many years ago. I place little or no value on the thousand and one "Experiments with Potatoes" which appear annually—mere repetitions with variations of what has been done scores of times during the past two hundred years, and generally with some important factor overlooked. Hence their uselessness for practical guidance.

On a farm having a fair range of soils four typical spots were selected for this test, all under the same natural conditions as to aspect, altitude, drainage, &c., &c. They received exactly the same cultural treatment, and at the same time; were each planted at the same time with twelve cut sets of the same lot of potatoes; each set had two eyes, and weighed 2 ozs., taken from the belt or middle of uniform tubers, and the sets were all planted eyes downwards. The returns in potatoes were, from—

A good strong loam	108 lb.
A good light loam	90 „
A sandy loam with gravel	59 „
A loamy sand	46 „

Other important matters were brought out by this test, but, not bearing on the point in question, are passed by.

hardship in the matter of cultivation, and leave the land in suitable condition for more fastidious crops. Some of our best crops of potatoes, largest in quantity, finest in quality, and handsomest in appearance, are grown on these newly-broken virgin soils without any manurial aid.

Old grass lands that have been grazed and manured by stock for years, especially by sheep, and particularly if the pasture consists of a good clover sod, are also excellent for this crop when ploughed over, and will frequently give heavy yields of sound, marketable tubers. These grass lands should be ploughed over in the autumn, taking care to cover in the turf to decay. Towards spring, and previous to planting, they should be again ploughed lightly and harrowed.

However, on a new farm a man cannot always get through the work exactly as he knows *how*, and *when*, it should be done; and it may happen to him, as it has to hundreds of others before, that these lands cannot be touched before it is actually time to put in the crop, and a little rougher culture than otherwise intended is, therefore, unavoidable. In such a case, the land may be ploughed in (say) 9 or 10 inch furrows, not more than 6 inches deep, and less if the soil is shallow, turning the grass or sod over, and covering as well as possible. The potato sets should be planted on the off side of every third furrow, and the next slice simply turned over on them. The boy dropper or planter may follow the horses in the furrow, walking backwards and forcing the seed into its true position, one foot apart, with the right hand, and having a quantity of the seed in an apron fastened round his waist, and held with the left hand. After the plough comes along, and has placed a furrow slice over the seed planted, it will be found that on the return trip on the other side of the land the furrow then opened is the correct one to plant in for that side. With lands (say) 5 chains long, three smart boys, each keeping to his own section of the furrows, and crossing over the land to the other furrow as he has finished planting the respective section, will keep a pair of active plough horses working at their best. If the land is at all tough, a plough should be used having a short mould-board, which will help greatly to break up or pulverise the furrow slices. After planting, the land may get a light harrowing, to be along the direction of the furrows. When the young plants appear above ground, and the rows can be distinctly seen, the horse-hoe or scarifier should be sent lightly through, to be repeated in a few days at a greater depth. This is the best substitute that can be given under the circumstances for the omitted autumn and winter workings.

It is not to be expected that under this method as large returns may be relied on as from properly-prepared land, nor do I for a moment advocate agricultural shortcuts, or make-shift methods of farming. The old saying, "What is worth doing is worth doing well," holds good on a farm equally as elsewhere. Those having clear farms should work to a system, and always have their work well in hand with the season; but with men struggling for new homes, with perhaps light pockets, these first-season's methods may be allowed. I have known this system followed for years when breaking up new lands, and generally with very successful results.

The potato crop is usually of sufficient importance to the farmer to be worthy of a careful selection and preparation of the soil. As its mechanical texture frequently enters largely into the question of success, the land must be well and deeply broken, and if it is not in good heart, a dressing should be given of whatever manures may be available; but if farmyard dung is used it should be rather old and well rotted, otherwise the plants run to haulm or tops, and the tubers are frequently inferior in quality. This manure should be covered in by an autumn ploughing, and the land left in rough ridges to the frosts and weather during the winter, to be reploughed (or cross-ploughed is preferable) and harrowed well into a good tilth by spring-time. Other manures suitable for this crop are bone-dust, superphosphate of lime, lime, wood ashes, potash, guano, and the preparations known as the Colonial Sugar Company's Fertilisers and Gee's Complete Manures. These may be applied broadcasted after the second ploughing and before the final harrowing; but if the farmer's stock of manure is limited—and I am more concerned about the farmer of limited means, the man of heavy labours and light pockets, especially if he recognises that he does not know everything—these latter manures, as well as the former ones, may be spread in the drills at planting time, when only a half or third quantity need be given.

The land being duly prepared, we will now give some attention to the seed or sets, before proceeding further in the matter of cultivation. Care should be exercised in the selection of the seed stock for planting, and inferior quality shunned, irrespective of price. Many farmers who think they save shillings in the price of the seed lose pounds in the price of their crop. In appearance the stock should be even in growth, regular in form, clean in the skin, true to colour and type as regards variety, with eyes well up to the surface, if not prominent. When handled it should have a firm but mellow feel, recognised by instant touch, and much appreciated by experienced growers. Now take a tuber and divide it lengthways with a sharp thin-bladed knife. It should pass through with ease and smoothness. Place the two halves together, and notice their adhesiveness, the strength of which, with the smoothness of cutting, indicate the rich nature of the food contents or quality. Should, however, the feel of the tuber be hard, the cut harsh, the adhesiveness weak, or the cut surface of the flesh show any discolouration, they indicate degeneration, and a weakened constitution liable to disease. These are probably due to a natural deficiency in the food constituents in the soil in which they were grown, or by reason of having succeeded potatoes or other crops which had previously abstracted the required elements. When spots are seen in the flesh, positive disease is evident. All such stocks are to be avoided.

The sets are either small whole tubers, too small for marketing as table potatoes; or the ordinary tubers cut into sets or sections, each having one, two, or more strong eyes or buds, and averaging two to two and half ounces in weight. From six to seven hundredweight of these will be required per acre. The cut sets should be prepared some hours, or a day before planting, to allow the wound or cut surface to heal. If the seed is sound and good as recommended, this healing will take place very quickly—well within the time mentioned. These may be safely used at the spring planting, or later if the season or soil is moist. The whole sets, or small tubers, are safer to use for summer planting, or in dry lands, being less subject to "dry rot," to which the cut sets would be very liable in a dry spell.

Planting may take place as early in the season as allowed by the clearing away of frosts. In the warmer, or earlier districts, this will be July and August; and in this case an autumn crop after the heat of summer may be planted (say) in February and March. In the uplands or cool districts where only one, or main, crop is usually obtainable, plantings are made from beginning of October to end of November, or perhaps later. Drills may be opened with either the single or double mould-board plough, 3 inches deep for early crops, and 4 to 5 inches for main crops later on. They should be struck out about 30 to 33 inches apart for field culture, 27 inches being the minimum width for horse work. The sets or seed may be planted, on an average, a foot apart in the drills, varying a little sometimes, according to the habit of growth of the particular variety being planted. Some profess to attach importance to the way the seed is placed in the ground with respect to the cut side being upwards or downwards. Personally, after a long experience, I am like the local justice who dismissed a case, thinking where so much could be said on both sides either party might be right, and neither would be wrong. The question is not worthy of consideration in our case, for nature may be safely relied on not to make any mistake about sending the shoots upwards and the roots downwards, and that as quickly as possible.

After the drills are planted they may be closed or covered by the hoe, plough, or harrow, at the discretion of the farmer. If the season be dry, a turn of the roller after closing would be advantageous in helping to retain any moisture. When the rows are visible, the ground should be stirred by a touch with the light seed-harrows. The farmer need not fear that this will tear all the potatoes up; but it will have a wonderful effect upon the crop in stimulating its growth. The crop must be kept clean, and should weeds appear the horse-hoe must go through. If the young plants are 4 or 5 inches high, the hoe may be set so as to give them a slight earthing or hilling at the time of cleaning. When they have grown to 6 or 12 inches, according to the variety, or whether they are of a dwarf or a large habit of growth, they may receive their earthing-up, or hilling, or ridging, as some call it, to the height of 3 to 6 inches.

This hilling or ridging may be done with a double mould-board or drill plough going between the rows, or a single plough going twice; and should be broad as the quantity of earth will allow, flat on top, or rather slightly hollowed along the centre. The advantage of this will be perceived when the plant has to depend on dews instead of rain. This operation is worth doing carefully, for the success of the crop depends largely on it, and if well done it should be found, when digging the crop, that fully half the returns, if not more, are grown in this ridging. Many experienced growers both advocate and practise double hilling, as they assert, with profit. Where this operation of hilling is insufficiently done the tubers, if not actually exposed, lie too near the surface, and by the action of the sun and light a chemical change takes place which renders them not only unpalatable, but unfit for human food. For this reason, when potatoes are cultivated "on the flat," as recommended by some, they must, in this country, be planted fully 6 inches deep, because the new tubers are not formed below the set planted, but above it.

Cultivation here usually ceases, and the crop may be allowed to grow unmolested to maturity and perfection.

Flowering and knotting of the tops are contemporaneous with the formation of new tubers; the approach of maturity will be indicated by the spotting of the leaves, and the failing in colour of the foliage generally. At this time, although the "new potatoes" are palatable and fairly wholesome as food, the skins of the tubers are not set. Fullness of growth and perfect ripeness are denoted by the firm setting of the skins and the death of the tops or haulm. After this the crop may be dug or removed from the ground, by fork or plough, when convenient; and when dug may be gathered and bagged for sale or stored. Any lengthened exposure to the sun in the field, however, must be avoided.

Whatever method of storing is adopted, whether in the barn or shed, or in heaps or pits in the field, the important points of dryness and ventilation are essential. To these must be added absence of light on the potatoes if they are intended for table purposes; but those desired for seed are better for having light sufficient to change their colour to a green tinge, after which they generally send out stronger shoots when planted.

Varieties.

The selection of a variety best adapted to the requirements of the district, and purposes for which the crop is intended, is also a matter of some consequence, for while one potato may give a heavy crop of fine quality in one place, or in one part of the season, it might be unprofitable, if not totally unsuitable, in another.

Our choice will be limited to a few varieties which have for a time most satisfactorily stood the severe tests incident to Australian agriculture. I will class them into early, medium, and late sorts, placing them in their order of maturing, and giving a short description of each.

Those called early are quick-growing sorts, suited to districts in which the temperature in the summer time is too high and continued too long for this crop to succeed. In such districts two crops are usually obtained annually by planting these quick varieties in the spring and autumn. The late kinds usually take from one to two months longer to grow, and are therefore more suited to districts where only one or main crop is usually planted; but such are the numerous gradations of climate in this Colony, that all these kinds are, more or less, interchangeable.

Early.

Triumph (Bliss's).—A round red-skinned potato, very early, productive, of attractive appearance, and fine quality. A great favourite with the growers of the valley of the Hunter, and frequently miscalled "Red Ruby" by them and others. Period of growth, eight to eleven weeks, according to situation.

Extra Early Vermont (Woodhouse).—Very similar in form and colour to the Early Rose, but much hardier, a better keeper, of finer quality, and more productive. Time, eight to eleven weeks, according to situation.

Early Rose (Woodhouse).—This potato is too well known to need any description; the true strain, which is now very difficult to obtain, is noted for its earliness, productiveness, and quality. Time, nine to twelve weeks.

Medium.

Snowflake (Pringle).—A very handsome, medium sized potato, with white russetted skin, and fine grained flesh of delicate flavour; productive, and a good keeper. A superb potato, and always saleable. Time, eleven to thirteen weeks.

Cambridge (Old Lapstone).—A flattish oval kidney potato with white flesh and skin; fairly productive and of a good quality. A good sort for selling as "new potatoes." Time, eleven to thirteen weeks.

Ruby (Pringle).—A beautiful deep red coloured potato, oblong in shape, flesh white, fine grained, and firm; mealy and of fine flavour when cooked. Productive. Time, eleven to thirteen weeks.

Prolific (Bressee).—Tubers large, regular, oblong and flattened; dull white skin, russetted. Flesh white, cooks quickly, and of excellent quality. Very productive. A good sort for sale as "new potatoes." Time, eleven to thirteen weeks.

Late.

Beauty (Brownell's).—Flattish oval-shaped tubers, of a reddish colour, medium to large in size. Flesh white and fine grained, and of a delicate flavour. A reliable cropper and good keeper. A standard variety. Time, eleven to fourteen weeks.

Manhattan.—A nearly round potato with dark purple skin, generally blotched with yellow. Flesh of fine grain, white, very solid, and of excellent quality. One of the most productive varieties in cultivation. Always in demand. Time, twelve to sixteen weeks.

Peerless (Bressee).—A beautiful white, round potato, of superior table qualities, and a heavy cropper. One of the best. Time, thirteen to sixteen weeks.

Blue Derwents (Circulars or Tasmanians).—A fine-skinned potato of blueish-red colour, white flesh, and fine quality when cooked. Reliable and productive in cool districts. Time, thirteen to sixteen weeks.

I have not been able to make up a list of twelve, for although there are numerous other well-known varieties they either do not come up to the standard of quality and productiveness, or they have not stood our tests for twenty years. The Superior, a grand potato, which ought to be included and placed sixth as regards ripening, I have omitted because I have not seen it much in the markets of late—surely an oversight on the part of growers, who want earliness, quality, quantity, and appearance. It will be noticed that our list includes four white-skinned sorts. They cannot be excluded. There is an objection on the part of many to white skins, because they require more care to keep them from the light; but any extra trouble of that sort is more than compensated by the extra quality and more delicate flavour usually found under white skins.

It is not easy nowadays to get true stocks, or stocks really suitable for seed purposes. Early Roses have greatly degenerated of late years, largely through inferior seed imported from other colonies; in fact, quantities that are sent here every season for sale as Early Rose are nothing of the kind, and disappoint unwary growers when planted for such. They are now yellow in the flesh, close in texture, irregular in shape, and inferior in every respect to those of the early seventies. Then I grew Early Rose which, when cooked, were beautifully white in colour and as light and porous as a snowflake.

Extra Early Vermont.—The true strain of this sort is now very difficult to obtain. The Early Rose is usually substituted by dealers, but is inferior to it in every point.

For *Snowflake*, the Prolific is very frequently substituted, being very similar in appearance, but always much cheaper. The imposition may be detected by examining the eyes; the former has a clear white eye, and sends out a green tinted bud, whilst the Prolific shows on both eye and bud a slight pink tinge. In the winter or early spring large quantities of a yellow-white potato, of inferior quality (the old *Fluke*) are sent to this Colony from the south, to be sold for seed purposes, and are put off as *Ashleaf Kidneys*, *Lapstone Kidneys*, *Cambridge Kidneys* or *Flukes*;—whatever the buyer may ask for, and this sort of thing will continue until growers are willing to pay for seed some advance on ordinary market rates. Any seed grower or dealer who is experienced, careful, and faithful to his customers, must have for his goods at *least double* the market prices for crops, and his stocks will pay the buyer the best.

Want of space and the pressure of other duties prevent me entering upon the subject of diseases to which the potato is liable, but I hope to give in an early issue of the *Agricultural Gazette* descriptions, with remedial and preventive measures, together with more extensive cultural details, and a wider range of interesting matters, gathered during twenty-five years of practical experience in the cultivation of this valuable crop.

Meanwhile, let the farmer watch that he does not himself bring these diseases on his new clean land with his *seed* and its *bags*. Use the utmost care in obtaining clean, sound seed from some experienced and reliable grower or some good seedsman who is equally careful. It is unwise to get seed even from a district known to have disease in it. Another source of danger is the second-hand potato sack—perhaps only brought on the farm to despatch the crop in—but it will frequently impregnate the land on which it has only stood to be filled. Distrust a strange potato sack as you would an enemy.

Dry Districts.

G. VALDER.

For the dry districts of the Colony, this is a very uncertain crop when cultivated in the ordinary method; but if given a little extra cultivation it responds very readily to the treatment.

Care should be taken to choose a piece of land of light sandy nature, although heavier soils, if worked thoroughly, will often do well. Plough this deeply and bring to a fine tilth with harrow.

Take a small plough, or Planet Junior cultivator, and cut out your furrows from 2 ft. 6 in. to 3 feet apart and about 6 inches deep. In these place the seeds about every 18 inches. I would recommend planting either medium-sized whole potatoes or large tubers cut into pieces of not less than 2 oz. in weight.

Mr. J. C. Arthur, D. Sc., Botanist to the Purdue University Experiment Station, La Fayette, Indiana, U.S.A., who carried out a number of exhaustive experiments on the "Relation of the number of eyes in the seed tuber to the product," proved that the number of eyes per piece is immaterial, but that the weight of the piece is a very important factor. He says: "The proper manner of cutting potatoes for planting, therefore, is to divide them into pieces of suitable weight, sized without regard to the distribution of the eyes. Instead of attempting to have one, two, or three eyed pieces, as the case may be, the approximation should be 1, 2, or 3 oz. pieces, or some other definite weight."

As soon as the tubers are planted cover them by using the plough or cultivator. If the climate in which the crop is to be grown is a hot, dry one, it is advisable not to hill the crop but cover just level with the surface and then stir between the drills. On this stirring much of the future of the crop depends. The best time to stir is after a heavy rain, or whenever the soil is inclined to cake on the surface. The best machine to use for this purpose is one of the Planet Junior type, having narrow blades. In hot dry climates it has been proved that flat culture is far superior to hilling, but in cold moist districts I believe that hilling is advantageous.

Regarding the varieties to plant, much depends on the climate soil, &c.; but for general purposes the following are some of the best:—Early Rose, Brownell's Beauty, Richter's Imperator, Bressee's Peerless, Albert Victor, The Model, Magnum Bonum, Early Puritan, and Lapstone Kidney.

In many parts of the Colony it will not pay to grow potatoes to any extent, but it is always advisable to try and produce sufficient for home use and have a small quantity for sale.

North Coast District.

G. M. McKEOWN.

Although the north-eastern districts cannot compare with many other parts of the Colony for potato-growing, there is no reason why sufficient for local consumption should not be produced.

The planting seasons are February and March for the winter crop, the summer crop being planted from July to September inclusive.

The land should be deeply worked and thoroughly pulverised. Drills should be opened 3 feet apart, and the sets placed 1 foot apart and covered with 6 inches of soil. Medium sized tubers should be planted, or if necessary to cut them the potatoes should be divided in halves lengthwise. If the potatoes are very large, in cutting them into sets, leave as large a portion as possible with each eye.

A dressing of wood ashes, or manure containing potash will be found beneficial.

Hilling in the heavier soils has been proved to be unnecessary, but in light volcanic soil in hot weather it will be required to some extent to protect the tubers from the heat, as soil of the latter type is often washed down by heavy rains, leaving the potatoes too close to the surface.

The work of harvesting should be performed in cloudy weather, as in summer the heat would injure the potatoes if left lying on the ground for even a short time.

The best varieties are Imperator, Early Rose, Early Puritan, Bliss' Triumph, and Brownell's Beauty.

As a protection against beetles, frequent applications of air-slaked lime or wood ashes to the foliage will be necessary, or where a spraying machine is available Paris green, in the proportion of 1 lb. to 150 gallons of water. For each ounce of the poison mix separately 2 oz. of flour, and then mix the whole together, keeping it well stirred while spraying.

Diseases.

Wet Rot.

Potatoes are liable to a number of diseases, of which Wet Rot and Potato Scab are very prevalent. They are also often attacked by the Potato Moth (*Lita solanella*). The following remedies are recommended:—

1. Carefully examine and reject any tubers that show signs of disease. If brownish spots are noticed near the margin, it is a sure sign of disease.

2. On no account must potatoes be planted in ground that has produced a diseased crop within two years.

3. All diseased tubers should be carefully gathered up and destroyed, either by fire or, if sufficiently good for the purpose, boiled and fed to pigs and fowls.

Potato Scab.

1. Discard scabby tubers as seed, or, if such potatoes must be used, they should be first soaked in a cold solution of 2 oz. of corrosive sublimate (*very poisonous substance*) to 16 gallons of water, made up in a wooden vessel such as a cask or wooden tub. Metal must *not* come into contact with this solution, or both the solution and the metal will be spoiled.

2. Land that has borne scabby potatoes will continue to infect new crops. It is, therefore, preferable to move to new land, and this should not be such as has received drainage from infected land.

3. In buying seed, stipulate that the seed shall come from a non-scabby crop.

These measures will rid any farm of scab in a season or two.

Potato Moth.

Several remedies have been proposed to prevent the attack of the larvæ by dipping the tubers into a distasteful solution, but we do not know of any of these remedies ever having been applied. Perhaps the labour attached to the application of such remedies is the obstacle to their adoption. To hinder the moth getting at the tubers seems to be the easiest preventive, and we see no reason why this might not be achieved by placing the potatoes in a pit, as it is done in Europe and America, for winter keeping. The moth cannot enter the ground to deposit its eggs upon the tubers whilst the potato is still growing, unless, perhaps, in such rare cases where the soil is much cracked. If, therefore, the potatoes are dug soon after they have become ripe, and placed in a pit before the moth can deposit eggs upon them, there is little danger of their being attacked.

The pits for keeping potatoes are constructed in the following manner:—A hole of about 4 to 5 feet in diameter is dug to a depth of from 1½ to 2 feet. The sides and bottom are smoothed, and the latter covered and the sides lined with a few inches of dry straw or rushes, the lining to stand above the margin of the hole. The potatoes are now placed into the hole and heaped up in a cone over it, and are then covered with 4 to 5 inches of straw, and then with 6 to 8 inches of soil that has to be beaten smooth to let the water run off.

The most recent treatment is: Formalin (a preservative fluid largely used in museums, costing about 6s. a gallon, 10 lb.), 8 oz. to 15 gallons water; soak the seed potatoes for two hours, and then cut and plant in the usual way.

SWEET POTATOES.

Ordinary Districts.

G. VALDER.

THIS crop does not receive anything like the attention it should. It forms a most valuable addition to the vegetable garden, and both potatoes and vines are good feed for stock.

Choose as sandy a piece of soil as you can. Plough this deeply and bring to a fine tilth.

Prepare a small bed in a warm portion of your farm. On this place the tubers almost close together. Cover lightly with some fine soil and keep the bed fairly moist. The tubers will soon send forth shoots, and these shoots are ready for planting out when from 6 inches to 1 foot in length. The best time to plant out is in the spring, as soon as the frosts are over—in most districts early in October. Of course, where a glass frame can be obtained it is advisable to plant the tubers under this, so that they can be brought on early. When the shoots are ready for planting out, plough the land into ridges from 8 to 10 inches high and 4 feet apart. Pull the shoots from off the tubers, and plant them in the ridges about 1 foot to 18 inches apart, putting them in deeply. If the shoots have grown to any length cut them in pieces of from 6 to 10 inches long. Place the tubers back in the bed and cover them over again. They will give a second and even third crop of shoots, which will be useful for late planting.

Work the soil between the rows and keep the weeds down. As soon as the vines begin to turn yellow, the tubers are ready for digging.

North Coast District.

G. M. McKEOWN.

These may be produced over a large portion of the Colony; but the best crops are to be obtained in the moist climate of the northern rivers districts.

Light soils of good depth, well drained and rich in vegetable matter, will give the best results.

The land should be thoroughly broken, the deeper the better, and formed into ridges not less than a foot wide at the top, and 3 feet apart from the middle of the ridges.

The best season for planting is from October to December inclusive.

The best method of propagation is by cuttings, which should be 1 foot long. The cuttings should be planted in the middle of the ridges, 1 foot apart, about one-third of each cutting being left above ground.

In light soil very little tillage will be necessary if the ground has previously been kept clean, as the vines cover the ridges so rapidly as to prevent the growth of weeds. The vines should be raised occasionally to prevent them from rooting at the numerous joints, and thus drawing nourishment from the main stem.

On the Richmond River Experiment Farm upwards of 15 tons of tubers per acre have been obtained without the aid of manure.

Apart from the value of the potatoes as human food, they, as well as the vines, form an excellent stock fodder. The potatoes may be kept for a considerable time during the winter by cutting the vines before frost sets in, and thickly covering the ground over the potatoes with straw; or they may be dug and stored safely if covered with dry sand and straw.

THE SUGAR-BEET.

THE desirability of introducing in the general system of cultivation a rotation beneficial both to the land and the ensuing crop, whilst leaving a profit besides, and the importance of establishing in this Colony an industry providing employment for a large number of persons, have led the Department of Agriculture to conduct during the last four years many experiments for the purpose of ascertaining the suitability of different districts for the profitable cultivation of the sugar-beet. Seed of all the most approved varieties were procured from France and Germany, and distributed to farmers throughout the Colony. Mr. C. A. Lee, M.P., has taken special interest in the beet industry in the Tenterfield district, and the experiments he has conducted on a large scale during the last three years have resulted so satisfactorily that a movement is now afoot to establish in the New England district a factory capable of treating a large quantity of beets. The following notes concerning the cultivation of the beet for sugar-making are from a lecture delivered by Mr. J. L. Thompson, Principal of the Hawkesbury Agricultural College, and an article by Mr. J. A. Despeissis, M.R.A.C.

Soil Suited for Sugar-Beet.

The soils most suitable for sugar-beet are well-drained, deep, friable loams. Porosity of surface and subsoil is desirable, to admit of superfluous water being drained away, of free circulation of the air, and to encourage power of absorbing and holding in a condition convenient for ready assimilation the elements of plant-food existing therein or applied in the form of manure. On calcareous soils the roots are generally small, yielding a juice of great purity, and rich in sugar. The subsoil has also an important influence on the quality of the root. Indeed, the physical properties of a soil are of more importance than the chemical, as the necessary food constituents can be supplied in the form of fertilisers. The Australian chocolate soils, derived from the disintegration of basalt, may be regarded as suitable for sugar-beet production.

Selection of Seed.

From the experiments that have been conducted the following varieties can be recommended for sugar production :—

Heina Vilmorin.
Vilmorin's Improved.
Paris Yellow.
Imperial Red.
White Silesian.

The composition of the seeds varies greatly, not only with the variety of the roots to which they belong, but with each other. This, with the size of the seeds, seems to have an actual influence on the resulting root. It has been proved by experiment in France that the larger the seed the larger the root, and the less percentage of sugar ; the smaller the seed the greater the amount of sugar found in the beet.

The density of the seeds is a good test—those sinking to the bottom in a vessel of water yield roots richest in sugar ; again, if the water has greatly changed its colour we may safely conclude that the seeds are old. It is difficult to make a distinction between the seeds of the sugar-beet and those of the mangel wurzel, as in external appearance they are very similar, both having rough capsules, each containing two and sometimes as many as four seeds.

Preparation of the Soil.

Land intended for sugar-beet should be taken in hand early in the autumn. Too much stress cannot be laid upon the necessity for careful preparation of the land. To obtain long, clean, properly-shaped roots the plants must have a sufficient depth of soil to grow in, as nothing fosters the development of side roots more than the stoppage of direct growth in the tap root by the hardness of the subsoil. Subsoil ploughing must therefore be resorted to. This can best be accomplished with two teams, the first an ordinary plough, turning a furrow (say) 6 or 8 inches deep. An ordinary plough with the mould-board taken off makes an excellent subsoiler, and this should follow the first plough, being regulated to stir the subsoil another 6 or 7 inches, a good 14 or 15 inches in all. This will be plenty deep enough for average sugar-beet. The root should be almost entirely buried in the soil. The land should remain in this rough condition throughout the winter, when it should be again ploughed if necessary, and thoroughly worked and pulverised by means of disc-harrows, rollers, or other implements, to ensure a perfect tilth, not only on the surface, but to a good depth.

Time for Sowing.

The best time for sowing throughout the New England district is September, and in other portions of the Colony planting should take place during spring.

Treatment of the Seed before Sowing.

In order to hasten germination the seed should be soaked for twenty-four or even thirty-six hours in a solution of one part rain-water and one part urine, human or bovine, at a temperature of 100 degrees to 120 degrees Fahr. Prolonged immersion in pure water removes from the seeds some of their soluble constituents. The seeds will absorb about their own weight of the mixture, and on being taken out should be mixed with some finely-pulverized wood ashes, dried on the surface, and are then ready for sowing. If the after-conditions as to heat, light, and air are satisfactory, the young plant should make its appearance in from eight to ten days.

Depth to Sow the Seed.

The most suitable depth is 1 inch if the ground is moist, and slightly deeper if the land is somewhat dry.

Distance Apart to Sow.

It is important to know the most suitable distance at which to place the roots advantageously to the farmer and the sugar-manufacturer. This varies with the soil, as the richer and deeper it is the closer the roots can be grown; a poor soil would require a greater number of square inches in surface to furnish the necessary nourishment than a rich one. Experiments and experience prove that roots of moderate size yield a juice which contains a smaller percentage of mineral and organic impurities, and afford a greater yield of sugar than large ones; and up to a certain point it must therefore be regarded as an axiom that the smaller the root the richer the sugar, and *vice versa*. The "ideal beet" should not be less than 1½ lb. or more than 2½ lb. in weight. As a general rule the distance in Europe is never more than 16 inches between the rows and 8 inches apart in the rows; this will give above 48,000 plants to the acre. A heavy seeding, sometimes in Europe as much as 30 lb. per acre, is given, as it is only by the liberal use of seed that a sufficiently close crop can be assured, especially under unfavourable conditions as to weather, &c. Considering our genial climate, the amount mentioned by Mr. Despeissis*, viz., from 16 to 20 lb. of seed would be sufficient, and this is confirmed by experiments conducted in New England for several seasons.

Method of Sowing.

Small plots of ¼ or ½ an acre for experimental purposes can of course easily be sown by hand; but when beet cultivation is carried out on an extensive scale a seed-drill should be used. The ordinary one-row horse-hoe is not suitable for beet cultivation; the rows, being only 16 inches apart, would not give sufficient room for working; it may be used, however, but is very slow, and great care is necessary in order that the young plants shall not be cut or destroyed. The Planet Junior Horse-hoe can be safely recommended for this work.

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* *Agricultural Gazette*, Vol. II, p. 127.

Thinning and After-Cultivation.

When the plants show four leaves the process of thinning should commence; if the rows be 16 inches apart a vigorous plant should be left every 8 inches. Careful selection should be made, and all puny plants destroyed. It is better to save the vigorous plants, even if regular intervals are not exactly preserved; but no space should be left in the rows greater than 12 inches, otherwise the roots will grow too large. Much of the thinning can be done by means of a narrow hoe; but to preserve the plants from injury hand-thinning must also be resorted to to a great extent. The plants having been carefully thinned, subsequent cultivation may be carried on by means of horse-power. Cultivation should be carried out at least once a fortnight during the period of growth; this is necessary for the two-fold purpose of keeping the crop entirely free from weeds, and preserving a proper tilth in the surface soil.

The necessity of thorough pulverisation of the soil during the period of growth of the beet cannot be too strongly urged. No crop derives more benefit from frequent hoeing than this; by stirring the surface soil air enters, dew is absorbed, and nitrification is encouraged.

It should here be mentioned that in some of the European beet-producing countries, when the crop is grown on a small scale, plants are raised in a bed in the same way as cabbages, and transplanted to their permanent positions. The principal objection to transplanting is that it is impossible to extract the young root without breaking it; the resulting beet would, in all probability, be forked; blanks in the field should, however, be filled up by transplanting.

Manures and Manuring.

The farmers in the sugar-beet districts will not require to give this subject immediate attention; for the rich volcanic or alluvial soils no manuring will be required, unless on land which has been under crop for a number of years. Next to the soil, manure has a powerful influence on the quality of the sugar-beet. Beet should not be grown in freshly-dunged soils, as the roots will be poor in sugar and overcharged with saline matter, which is dreaded by the manufacturer of sugar, as it largely prevents the successful extraction of the crystallisable sugar. Farm-yard manure should be applied to the previous crop, or at least some months before the beet seeds are sown. If the land is very poor it will be impossible to grow anything like a crop without manure; in that case manure must be applied. A mixture of guano, bonedust, superphosphate, and sulphate of potash, at the rate of 3 cwt. per acre, will give good results. Ammoniacal salts, guano, rich dung, and, in general, all nitrogenous manures require to be used with caution, as they tend to encourage luxuriant growth of "tops," and to diminish the percentage of sugar in the roots. A certain amount of available nitrogen in the soil appears to be necessary for the healthy development of the plant. Superphosphate of lime may be applied to the land with excellent effect at the time when the seed is drilled in. For soils in good agricultural condition an extra supply of nitrogenous organic matter or ready-formed ammonia does harm, inasmuch as, though it produces a heavy crop, it both diminishes the percentage of sugar in the roots and prevents the manufacturer obtaining in a crystallised form as large an amount of sugar as he can obtain from beet containing the same percentage of sugar but grown without the use of nitrogenous manure. The chief constituents taken from the soil and found in the root and leaves of the beet are potash, phosphoric acid, magnesia, nitrogen. It has been found that a sugar-beet crop yielding the moderate result of 15 tons of roots and 3·6 tons of leaves abstracts the following quantities of solid matter from the soil:—

	Roots. lb.	Leaves. lb.	Total. lb.
Nitrogen	59·4	26·4	85·8
Potash	132	52·8	184·8
Phosphoric acid	26·4	11	37·4
Other substances...	85·8	79·2	165
Totals	303·6	179·4	473

The removal of Leaves during growth of Beet.

This practice is not recommended. Experience and exhaustive experiments have proved that the stripping of the leaves injuriously affects the production of saccharine elements.

Ripening and Harvesting.

The roots should not be harvested until quite ripe. This stage is recognised by the leaves turning yellow and becoming flabby. A good indication of maturity is afforded when a root is cut in two with a knife; if the newly-cut surfaces of the beet rapidly change colour on exposure to the air the ripening process is not completed; if, however, they remain unchanged or turn only slightly reddish, it may be taken for granted that they are sufficiently ripe to be harvested. On no consideration must the roots be exposed to heavy frosts, In the sugar-beet-growing countries on the continent of Europe the growers have machines for raising the roots. When grown on a small scale the roots may be raised with a pick or the plough, but great care should be taken that none of the roots are pricked or bruised, otherwise they will be liable to decay. When the roots are taken from the ground they should be shaken, in order to get rid of any earth adhering to them. The leaves should be separated from the roots either by means of a knife or a sharp spade, care being taken not to cut any part of the root except the neck. The object of removing this portion of the beet is to prevent the mineral salts which have accumulated therein in large quantities from entering the factory. If the roots cannot be carried at once to the factory or silo they should be covered up with their leaves in the field or else with 3 or 4 inches of earth.

Storage of Roots.

A factory having made arrangements for a full supply of roots would not be able to take all at once, a large proportion of the crop must, therefore, be stored until required for use.

In storing special care should be taken to prevent the roots from throwing out fresh tops, as this is attended by loss of sugar. They may be stored in heaps covered with dry earth in the same way as potatoes are kept in many districts, or put in a silo at a low temperature, not to exceed (say) 50 degrees F.

Saving Seed of Sugar-beet.

In selecting plants for the purpose of procuring seed, only uniform well-shaped roots should be used. The tops should be carefully rubbed off, not cut; they should be stored in heaps or silos until the following spring, when they should be planted out in squares, about 3 feet apart. The root will soon show signs of life, flowers will appear, and abundance of seed will be produced, not less than 15 cwt. to the acre.

Harvesting is accomplished by cutting off the tops whole and tying them together in bundles; they are kept until quite dry, and then the seed is threshed out by means of a flail, or, if on a large scale by means of an ordinary threshing machine. In sowing the seeds the roots of different varieties should be planted a considerable distance apart to prevent cross-fertilisation.

For seed production, only such roots as are rich in sugar should be selected. A test as to their specific gravity can be easily taken in this way. Take a large tub or barrel and fill it with water, dissolve in this a quantity of salt or sugar until a required density is reached, in the same way as is done in preparing a pickle for curing meat, generally strong enough to float an egg or a potato; wash the roots perfectly clean and put them into the liquid; select for seed those that sink and reject those that float. Another method is to ascertain the specific gravity of the juice in the root; this may be done by boring out of the roots small pieces, the juice must be pressed out and tested with a saccharometer. The hole is filled up with sand, and the root is not damaged in any way, so far as its seed-producing power is concerned. M. Vilmorin brought this method under notice in 1851.

Approximate cost of producing an acre of Sugar-beet in New South Wales.

	£	s.	d.
Ploughing and subsoiling, 14 inches deep	2	5	0
Second ploughing in spring	0	7	6
Preparing seed-bed	0	10	0
Seed and sowing	0	12	0
Hand-hoeing and singling	0	15	0
Horse-hoeing three times and hilling	0	15	0
Harvesting...	1	5	0
Carting to factory...	1	2	6
Take cost for 1 acre	£7	12	0
Return on same—			
Sixteen tons roots at per ton 16s.	12	16	0
Profit per acre (for the use of land and interest on outlay)	5	4	0

Place in the rotation.

Beet should follow a white straw crop; it should, if possible, be made to be preceded by and succeeded by a grain crop. Clover or leguminous crops of any kind being nitrogen gatherers should not precede beet; for, under such circumstances, although the roots grow to a large size they remain poor in sugar and take up too much saline matter. All experience points to the fact that repeated sowing of beet on the same land is ruinous to the cultivator, even when immense quantities of farm-yard manure are applied, and where a return is made to the land of all the constituents taken from it by the beet.

A favourite rotation on some of the Austrian beet farms is as follows:— 1. Cereal crop; 2. Sugar-beet; 3. Cereal crop; 4. Lucerne, clover, or grasses; cereal crop, and then beet again.

Mr. Salatnay, in his articles in the *Melbourne Age*, estimates the probable yield at 19 tons per acre, this at 16s. per ton gives a gross return of £15 4s. per acre, and he gives the cost of production at £7 10s. I prefer, myself, rather to under than over estimate the return. Experiments at Tenterfield have realised 20 tons per acre, and at Wagga Wagga in a dry season 14 tons have been raised.

As a Fodder.

The sugar-beet is a valuable fodder, and will pay to grow for this purpose in all the colder portions of the Colony. It will keep well in pits, and when pulped or crushed and mixed with hay or chaff can scarcely be excelled for milch cows.

The waste products from sugar factories consist of molasses and refuse pulp. This pulp makes an excellent cattle food, its value being fully 20 per cent. that of the beet; it possesses important fattening qualities, and it is regarded by some as equal, if not superior in nutritive properties, to the roots from which it is obtained. The pulp may be fed in a fresh state, or preserved in silos; it can also be evaporated and kept in a dry state for any length of time. It is given to fattening beasts mixed with chaff, meal, or other food material. Mr. E. Clarke, in his article on "Sugar-beet cultivation in Austria" in the Journal of Royal Agricultural Society of England, describes a place at Lundenburg where 2,000 cattle are fattened every year; some of them consist of beasts that have done their share of work in the fields, but the majority are bought expressly for fattening purposes. The fattening process only takes 150 days.

Enemies of the Sugar-beet.

Like all other plants, the sugar-beet has its enemies, some insect, others fungoid. In Europe numerous insects damage this crop. The larvæ of cockchafers feed on the roots; weevil larvæ bore into the root and leaf; grubs of many other insects feed on the leaves. A singular disease called "Brown penetration" exhibits in the roots a brown diseased centre which eventually kills the plant. In some cases the plant develops hollow centres. The leaves are attacked by a red-rust fungus, which may do much damage; several other fungous pests are known causing either white spots on the leaf-stalks or the leaves to dry up and become black. Some of these troubles are caused by the plants having been grown too long as successive crops on the same ground, thus showing the value of a proper rotation.

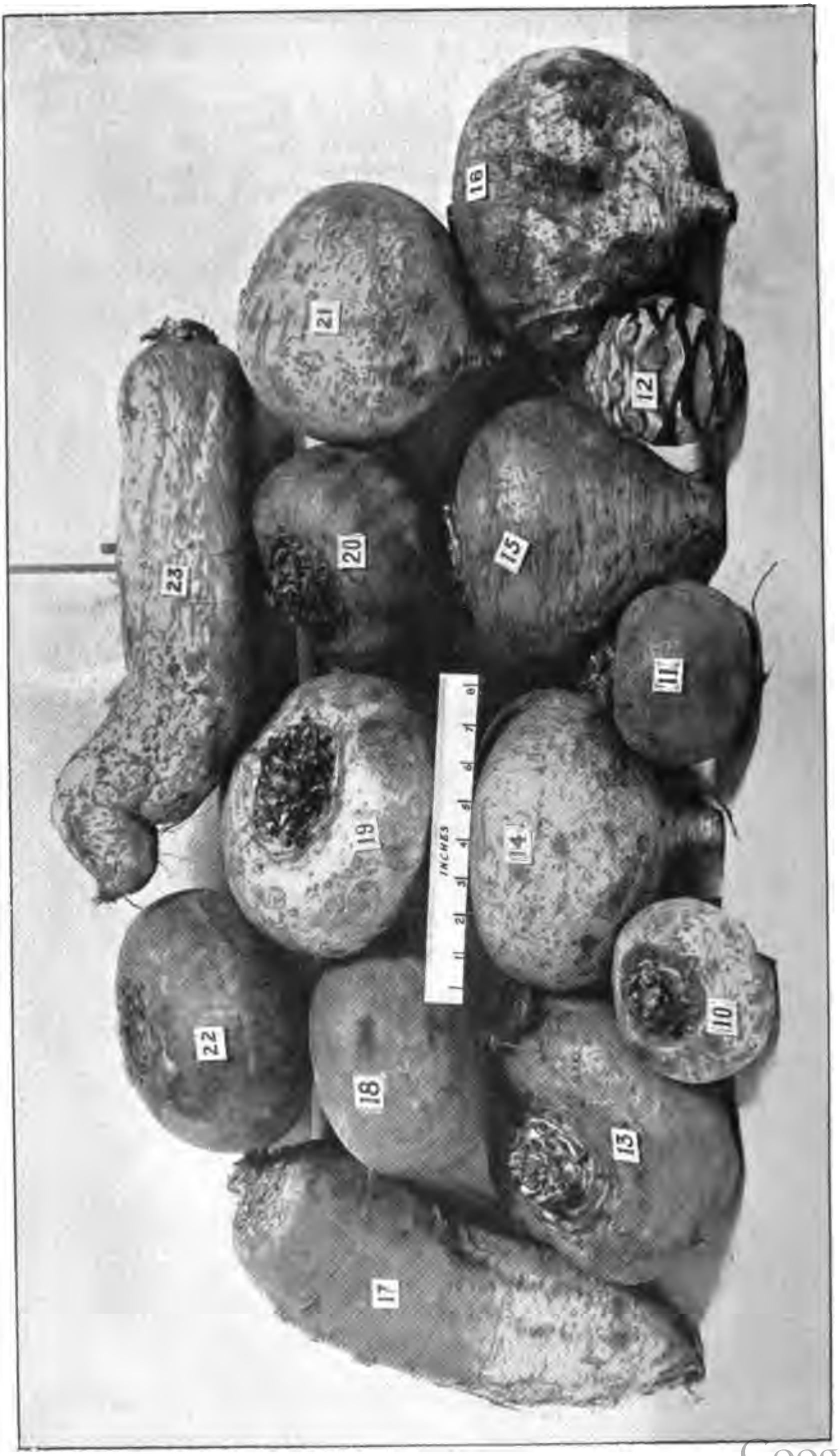
So far as we in New South Wales are concerned, a sharp look out should be kept, and immediate measures taken to prevent serious damage, should occasion require. Any attack to be warded off should be nipped in the bud by the application of such remedies as would be likely to bring about the desired result.

If grubs are feeding on the leaves, apply Paris green as a liquid spray, 1 lb. to 200 gallons of water, adding 2 quarts of flour—the ingredients to be each well mixed up with a little water before adding the bulk.

In case of travelling caterpillars, for instance the Army worm, which, if in great numbers, will do much damage, they must be kept out of the crop by ploughing a furrow round it, the land side (towards crop) to be undercut by means of a spade so as to present an overhanging wall of earth, up this the grubs cannot crawl; boiling-water should be freely used to kill them as they accumulate in the furrow.

Burrowing insects are difficult to get at; they can be prevented from laying their eggs, however, by sprinkling over the plants lime and soot.

To guard against fungous pests it would be well to soak all seeds in water having bluestone in it in the same way as we steep grain to keep down smut. In the case of any fungus appearing in the crop, specimens should be immediately despatched to the Department of Agriculture for identification and advice.



TYPICAL SPECIMENS OF TURNIPS GROWN AT WAGGA.

10. Early White Nepaul.
11. Orange Jelly.
12. Kohl Rabi, Purple.
13. Red-top Munich.
14. White Stone
15. Devonshire Greystone.
16. Purple-top Mammoth.
17. Yellow Tankard.
18. Green top Yellow Aberdeen.
19. Early Red American.
20. Purple-top Yellow Aberdeen.
21. Pomeranian White Globe.
22. Green-top Stone.
23. Long White.

MANGOLDS (MANGEL WURZEL).

G. VALDER.

THIS is another root crop which is of great value for stock feed. It requires much the same cultivation as sugar-beet, but the plants require much more room. The seed should be sown in drills 2 ft. 6 in. to 3 feet apart, and the plants be thinned out to 1 foot to 18 inches apart.

In the colder portions of the Colony enormous crops of mangolds could be produced at a small expense. They are especially valuable for feeding to stud sheep and cattle.

Further particulars *re* this crop are given in chapter on Crossbred Sheep.

TURNIPS AND SWEDES.

G. VALDER.

BY experiments carried out at Wagga Wagga Experiment Farm and elsewhere, it has been proved that enormous crops of turnips of first-class quality can be produced in this Colony at a very small expenditure.

Almost any of our wheat lands, in districts having a rainfall averaging not less than 20 inches per annum, are very suitable for this crop.

As soon as the farmer has harvested his wheat, oats, or barley crops he should get ready to plough a portion of his land for a turnip crop. This is best done directly the first rain comes after harvest. Then let the land remain till the rains come, which are generally experienced in January or February. As soon as possible break the soil down by means of roller, harrows, and cultivator, until it is brought to a fine tilth, taking care that the soil is kept well loosened. Then sow in drills about 2 feet to 2 ft. 6 in. apart. There are several machines obtainable, which will drill turnip seed in and make very good work of it. From 1 to 2 lb. of seed per acre is ample, the smaller quantity being preferable. Of course, where a drill is not obtainable the farmer will have to sow broadcast; he will then require 3 lb. to 4 lb. of seed per acre. Good crops of turnips are often obtained when broad-casted; but, as a rule, a far greater crop is obtainable when the crop is drilled in.

As soon as the young plants are about 1 to 2 inches high, it is advisable to thin them out. For a field crop the plants should be from 12 to 15 inches apart in the drills. The thinning out is best done with a sharp hoe. Provided that the seed has been carefully sown, the thinning out can be rapidly accomplished.

The soil must be kept well loosened up between the drills with a horse-hoe. This will keep down the weeds, and retain the moisture in the soil. Besides this, any rain that falls will go right in, and not run off, as is often the case when the soil is allowed to form a crust. By cultivating the crop on this system I have obtained large crops of turnips in dry seasons. I cannot too strongly recommend farmers when sowing root crops to be sure that the seed-bed is well pulverised, and the soil not too firm. In cold, moist climates, such as that of the countries of Northern Europe, it is customary to roll the soil well, so that a firm seed-bed may be obtained; but in this Colony this custom is a very dangerous one, as should a dry season set in the crop is almost sure to fail.

Varieties for Table Use.

Turnips.

Red-top Munich.—A very showy turnip, having a beautiful snowy white flesh, succulent, and of very fine flavour. Comes in early, and is a heavy cropper. Produced less foliage than any other variety, and stood the hot dry weather remarkably well.

Of the other table turnips, White Stone and Red-top American appeared to be by far the best varieties. Orange Jelly is a very first-class table variety as far as quality is concerned, but does not crop well.

Swedes.

Of the Swedes the two green-top varieties were found to be the best flavoured, but they did not stand the dry weather. Anderson's Imperial, Sutton's Champion, and Yates' Champion are good table sorts. Yellow Tankard is also a variety which I can strongly recommend for table use.

Varieties for Stock Feed.

Turnips.

Green-top Stone.—A fairly large and even-sized turnip; is a good keeper, being very firm, flesh white. This variety should be a good one for the drier portion of this Colony, as it stands the warm dry weather remarkably well.

Purple-top Mammoth.—A large and heavy cropping variety; flesh solid and succulent. Is good for early feeding; should not be allowed to grow too large.

Green-top Yellow Aberdeen.—Much resembles Green-top Stone, but is yellow fleshed. In good seasons is a very heavy cropper.

The above three varieties appear to be by far the best for cultivation in the warmer portions of the Colony, standing the dry weather well, and producing a crop of even roots with very solid and nutritious flesh.

Of the Swedes, Anderson's Imperial, Sutton's Champion, Skirving's Purple-top, and Monarch Purple-top are all suitable for stock feed, and are good even croppers. Anderson's Imperial is a first-class variety; the roots being very even, solid, and good quality.

Turnips are always useful for stock feed, and there is often a large demand for them for table use, at prices ranging from £2 to £6 per ton.

They can be pulled and stored in pits for months. When pulling, the leaves (which are trimmed off) come in very useful for stock feed.

In a bad season, I believe, at least 15 tons per acre, and in a good one, from 25 to 30 tons per acre, can easily be obtained in many parts of this Colony.

Diseases.

The turnip, like most cruciferous plants, is subject to several insect and fungous pests, chief among which is the "fly." It will scarcely pay to spray large areas of turnips with insecticides, and the best means to adopt is to stimulate the crop to such an extent by means of good cultivation that the plants may resist the ravages.

White Rust of the Cabbage, Turnip, &c. (*Cystopus candidus*, Lev.)

This disease is rather common on turnip, cabbage, horse-radish, and other cultivated cruciferous plants, as well as on a large number of introduced and native cruciferous weeds, especially when they grow in moist situations. The fungus causing the disease (*Cystopus candidus*, Lev.) occurs in whitish areas on the leaves and other parts of the plants. These areas are at first covered by the cuticle of the host plant, and present the appearance of white blisters.

This fungus in certain stages is deceptive, giving rise to the opinion that the affected plant is suffering from the encroachments of some insect or mite. The white blister-like pustules resemble the galleries of certain mites, and when the blisters break, their white colour often changes to a dirty yellow, and this heightens the deception. Microscopic examination, however, at once dispels the illusion; for when a bit of the fungus is viewed under the microscope it is at once seen to be composed of delicate chains of transparent nearly spherical spores, as shown in the *Agricultural Gazette.* If these spores are placed for an hour or two in water, each of them gives rise to several minute free swimming zoospores, each having two vibratile ciliæ as organs of locomotion. These are the bodies through whose agency this disease spreads; their number, under conditions favourable to them, is inconceivably great, and the disease is therefore capable of spreading with considerable rapidity.

Remedies.

1. Rotation of crops.
2. Clean cultivation. Under this head, which is doubtless strongly advisable in cold countries, I must add that I think it uncertain whether the fungus in this climate requires to pass the winter in its resting-spore state; hence it is also uncertain whether the careful destruction of all overground parts would be as effective here as in colder climates.
3. Destruction of cruciferous weeds, such as mustard, shepherd's purse, &c., which also harbour this fungus.
4. It would be well to try the effect of some sprays and powders. I would recommend a trial of (*a*) pulverised lime; (*b*) flowers of sulphur; (*c*) spray of *eau céleste*, made as follows:—

Copper sulphate (blue-stone)... ...	1 lb.
Ammonia	1½ pint.
Water	22 gals.

Dissolve the blue-stone, and add the ammonia. (N. A. Cobb.)

CHICORY (*Cichorium intybus*, Linn.).

BY G. VALDER.

CHICORY is used extensively as a substitute for, or an admixture in, coffee, and while it is condemned by some as being entirely destitute of those properties which render it wholesome for constant use, others maintain that it is one of the most harmless substances that has ever been used for the adulteration of coffee, and that the combination of a little chicory gives a richness of flavour, which many persons prefer to the pure article, when mixed at the rate of 2 oz. pure chicory to 1 lb. of coffee. It has also been tried as ensilage with great success.

Cultivation.

The culture of chicory is the same as that of the parsnip, carrot, &c. It thrives best in a rich light soil (rich loam, sandy and calcareous soils are best), and should in every instance have an open situation allotted to it. The soil should be deeply worked and well pulverised. Sowing for main crop in New South Wales lasts from September to November, according to locality. The seeds should be sown in drills, 1 inch deep, 2 feet apart, and the plants should be carefully thinned out to 9 inches in the drills. 2 lb. or even less seed per acre is ample when sown in drills. When the plants are about an inch high, or when weeds appear, the process of hoeing commences. This operation should be carried out about once a month, or as the weeds appear. The crop commences to ripen in April, the harvest lasting from the beginning of April until July.

Digging.

The great objection to chicory is that, like horse-radish, every particle of root left in the ground will grow. Therefore, it is necessary to be very particular in taking up all the roots of the crop from a good depth. This is the most troublesome work connected with the growth of the crop. In America the roots are generally ploughed up, men following the plough armed with a long hook, taking up any roots that may have been left in the ground; but, as a rule, it will be found much better to dig up the roots with strong forks. The roots are thrown into heaps, carted from the fields, and thoroughly washed. Revolving root-washing machines will be found to answer best for the purpose, and this operation finishes their preparation for market.

As a forage crop, chicory is generally sown broadcast at the rate of 5 lb. to the acre, the time most suitable being from September to November, and for winter feed in February or March. When the plant is coming into flower (about four months from sowing), cut and feed to cattle, sheep, and pigs, &c. For small farmers and dairymen it cannot be too strongly recommended. It is said that it will produce, on poor sandy soils, a larger quantity of green food than any other plant in cultivation.

Preparation of Roots.

The roots are prepared as soon after pulling as possible. They are first thoroughly washed, then placed in the cutter and cut into the thinnest possible slices, after which they are slowly dried in kilns, having preferably revolving floors and automatic turners. It is then passed through sizing, sorting, and sifting machines, after which it goes to the roasters, where it is carefully roasted to the proper degree. After that it passes on to the nibbling machines, then through the grinding mills, and from thence through wire or silk dressers, after which it is promptly packed into soldered air-tight canisters, and again packed into cases ready for market.

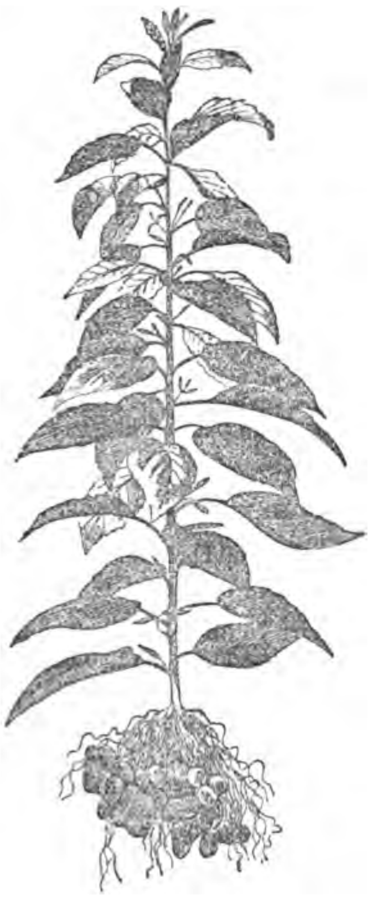
Chicory has not as yet received much attention from farmers in New South Wales, although it has been cultivated in small quantities as a forage plant for many years. It is now being grown for its root (principally in the Blayney district) for the Sydney market. Good washed chicory roots are worth on an average about £5 per ton delivered in Sydney. The yield per acre ranges from 8 tons in favourable seasons to as low as 1 ton in dry seasons. With irrigation, from 6 to 8 tons per acre can be produced. In California, as much as 15 tons per acre has been produced on rich loamy soils, and with irrigation the crop rarely averages less than 10 tons per acre. Chicory is much more extensively grown in New Zealand and Victoria than in New South Wales. The average price in Victoria ranges from £4 to £6 per ton for washed roots. The amount of roots consumed in New South Wales averages about 1,000 tons yearly (equal to about 160 tons of prepared chicory). The usual plan in New South Wales is for the merchant to contract with the grower to take the produce of a stated number of acres. In bad seasons large quantities of root are imported from Melbourne; but as there is a very heavy Customs duty, this would not be done if the root could be obtained here.

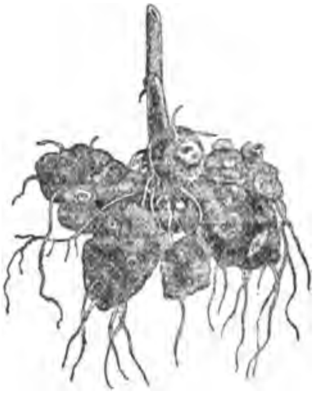
Although the market for chicory is limited, there is no reason why a larger quantity should not be grown in the Colony. Besides the value of the plant and root for human food, it would be of great value to the farmers and dairymen of the South Coast and other cool parts of New South Wales as a forage crop. A statistical return shows that there was a total quantity of 167,043 lb. imported and valued at £1,533, and an export trade of 14,672 lb., valued at £163, from the Colony. In Victoria, during 1889, 148 acres were sown with chicory, producing 811 tons of the root.

THE JERUSALEM ARTICHOKE.

By J. A. DESPEISSIS, M.R.A.C.

The Jerusalem artichoke is a perennial plant of the sunflower genus, with erect stems 5 to 8 feet in height, but producing year after year underground shoots, which are swollen into genuine tubers, of a violet-red colour, about 2 inches in diameter, marked with hollows and scale-like enlargements. Its area of cultivation extends from the south of France and Italy to Norway.





Like the potato, the tubers (*Rhizomes*) are used for culinary purposes, whilst, as a fodder, they increase the milk of cows to an extraordinary degree, and are preferable in many respects to potatoes for feeding pigs. Horses, cows, and sheep eat them, too, with a relish, preferring them even to corn. The illustrations refer to the aspect and the habit of growth of the plant, and the way the tubers are attached in cluster to its roots.

Jerusalem artichokes, under the name of *Topinambour*, are extensively cultivated in France for distilling purposes, as are potatoes and beet-roots, yielding as much as 7 to 9 per cent. of absolute alcohol.

The composition of these tubers varies very much, according to the time they are pulled up. The percentage of *crystalline* sugar is largest during the cold season, while, during the summer, the starch-like, inulin, gummy matters and glucose prevail. The tubers form very late, and should not be dug before the stems have nearly ceased growing, viz., in the autumn.

The plant is propagated from the smallest tubers and planted like the potatoes, in the spring, but they are not cut or divided previous to planting, and they are also put at a greater distance apart, viz., 8 feet between the rows and 2 feet in the lines. It sprouts rapidly and is allowed to grow unchecked without being earthed up. It flourishes in a wider range of soils and climate than the potato, and may with considerable advantage be grown in rotation with maize.

With regard to the nutritious value of the tubers of the Jerusalem artichoke, as compared with potatoes and beet root, the former contain considerably more nitrogenous substances, or flesh formers, and about the same quantity of carbo-hydrates, or heat producers, and it is estimated that feeding with the tubers of Jerusalem artichokes bring the pound of meat to about half the price, as compared with feeding with beet root, and about three-fourths, as compared with feeding with potatoes.

As a crop for hog feed it can hardly be excelled.

An important element of their value for swine and cattle feeding is in their availability when the ground does not remain frozen during the entire winter and spring, the tubers being dug as they are wanted, without any cost for harvesting. They do not stand storing in pits or silos like beet roots and potatoes and are little susceptible to frost.

The leaves of Jerusalem artichokes, besides, constitute a very good fodder for stock. The stalks grow to a height of 6 to 9 feet. The plant does best in good soils and in the open, but it is also in a peculiar manner fitted to grow in the shade, and it can therefore be cultivated in woods, and, for this reason, is sometimes grown as cover for game, being left to reproduce itself annually from tubers. It is very often planted on gravelly pieces of ground that would be too dry for other crops, such as knolls and mounds, and it is also grown to utilise the space along the sides of hedges and in shady places.

They do remarkably well in all sorts of soil, from the light soils—too sandy for corn and "hot enough to roast an egg"—to swampy soil, where beet roots could not be grown.

An average yield in fair soils, in which 14 tons of beet roots would be raised, would be about 8 tons of Jerusalem artichokes, while, in the case of potatoes, the yield would be 6 tons.

In good soil, well manured, that would produce 75 bushels of maize to the acre, the yield of Jerulalem artichokes has been found to reach 1,600 bushels or about 30 tons.

In a good average season, however, and in soils of medium quality, 800 bushels, or 12 tons, to the acre is of common occurrence.

One of the best varieties of Jerusalem artichokes is the one known as *Red Brazilian.* On the table it is often served boiled, but is excellent baked, the flavour being richer and better this way.

As this crop removes from the ground a notable quantity of mineral salts, the farmers should only grow it in rotation with maize and other crops. It is sometimes grown for several years in succession in the same field, care being taken to plant each season the space between the lines, provided some manures, such as nitrogenous and potassic manures, be applied to the ground to make good the loss entailed on the ground by the removal of the crop.

Forage Crops.

LUCERNE (*Medicago sativa*, Linn.)

THERE is diversity of opinion as to the best method of sowing this crop, and in order that the fullest details may be placed before the intending lucerne-grower we give the views of Mr. Thompson, who advocates broadcasting; of Mr. Valder, who has achieved excellent results from drilling; and the report of Mr. Stock-Inspector Watson on the system adopted by a number of pastoralists who have put down for pasture thousands of acres of this crop in the Corowa District.

At the Pera Bore Experiment Farm, near Bourke, splendid lucerne is produced under irrigation, and the manner of applying the water is described by Mr. Gorman at page 100. It may be added that the general practice in the Hunter River District, whence the bulk of lucerne hay is received, is broadcasting about 15 to 20 lb. to the acre.

I.

J. L. THOMPSON.

Soil most Suitable.

Lucerne prefers a deep, well-drained calcareous loam, where it can send its roots deep down into the subsoil out of reach of droughts. It will keep green and luxuriant during the hottest months of summer, and is always ready to respond to a genial summer shower, or to irrigation. There are three conditions under which lucerne will attain to great perfection in this Colony:—

1st. When the roots of the plant can penetrate to the natural water.

2nd. When the soil is a friable loam, and the subsoil is composed of fairly retentive clay. I mean by retentive when it will hold the moisture during the dry summer months. One can soon find out by sinking a hole if the subsoil is retentive or not in this way: during a period of dry weather, if the subsoil has sufficient moisture to make into a ball, it is considered retentive enough, but if it crumbles away in your hand it is too dry. Some experts use this simple test for ascertaining the retentive qualities of the subsoil, and its suitability for vines, olives, &c.

3rd. Where it can be irrigated (*see* p. 100).

Preparation of the Soil.

If the nature of the subsoil is such that the roots of the plant cannot penetrate easily through it the subsoil plough should be brought into use, and the subsoil loosened fully 18 inches deep. This can best be accomplished with two ploughs and teams, the first turning a furrow, say, 8 inches deep, in the ordinary way; the second plough (with the mould-board taken off), with three good horses, will break up the subsoil another 10 inches—18 inches in all. Under no circumstances do I recommend the soil to be inverted, as the surface soil, prepared by nature for the growth of plants, should be allowed to remain in its natural position. Land with an open subsoil will not require subsoiling, but in any case the land should be well ploughed and worked deeply with a scarifier, and brought to a fine tilth by means of disc cultivators, roller, harrows, &c. It is absolutely necessary to have fine loose open soil, so that the tiny seed may not be lost among the big clods, and that it may have every opportunity to germinate and take root. In short, the soil should be almost like that of the proverbial onion-bed. It is best to sow the seed on the smooth surface after the roller, and not on rough lumpy soil. One stroke of a very light harrow will be sufficient to cover the seed. Many small seeds, like lucerne, are buried too deeply, and never germinate, and the seedsman is blamed for sending inferior seed. From a quarter to half an inch of covering is quite sufficient.

Testing Seed.

As so much is at stake in sowing large areas of lucerne, it would in all cases be wise to test the germinating power of the seed before purchasing or sowing. If time will permit, 100 average seeds can be sown in a box filled with nice loam; if put in a warm sheltered corner and kept moist they will soon germinate, and the number of plants can easily be counted. A quicker method is to put the seeds between two pieces of flannel, and by keeping them moist and warm these will germinate in less than forty-eight hours. Some of the leading seedsmen give a germinating percentage guarantee, *i.e*, they guarantee that under ordinarily favourable conditions a certain percentage of the seeds will germinate.

Sowing Lucerne.

It is very difficult to sow small seeds, like lucerne, evenly by hand; the seeds will slip through your fingers in spite of the greatest care, and the sowing will be irregular. It is also impossible to throw small seeds any great distance. A machine is therefore indispensable to sow lucerne-seed properly, if much has to be accomplished. The one we have on the College farm cost only £5 delivered in Sydney, and full particulars regarding it can be obtained at the Department. It is 12 feet long, and capable of sowing from 20 to 30 acres per day. On well-prepared land, after the roller, it can be pushed along as easily as an empty wheelbarrow. Although the machine is 12 feet long it should only cover 11 feet, one-sixth of a chain at one turn, thus allowing 6 inches at each end for lap. In working the machine, poles are put in perfectly straight in line, say, every 5 chains along the line, and as these are knocked out by the wheel of the machine, 11 feet are measured off with a light deal rod exactly that length, and the poles put in for the journey. This is continued until the whole of the field is sown, and if care is taken the sowing can be completed without a single blemish.

Drilling versus Broadcast Sowing.

Although many experienced men advocate drilling instead of sowing the seed broadcast, I must confess that, from an experience of over twenty-four years in the growing of this plant, I am strongly of opinion that broadcast sowing is to be preferred. Unless the spaces between the drills can be kept constantly clean and free from weeds, they have a tendency to get full of weeds, and thus in time choke the plant, and consequently soon ruin it. If sown in rows or drills there is certainly a saving of seed, but I believe in a liberal broadcast seeding so as to ensure a good healthy covering of the whole surface, so as to choke out all weeds as early as possible. Ten or 12 inches apart in the drills is the usual distance. It is not advisable to break up virgin soil and sow lucerne as a first crop; a preparatory crop of cereals or roots is most desirable. Many large farmers in this Colony, and also in Victoria, take two cereal crops, and then sow down with lucerne.

Lucerne does not do well when sown along with a cereal crop. It is much better to give it full possession of the soil.

The best time to sow Lucerne.

In districts where the winter frosts are not too severe, and the summer months comparatively dry, I would recommend the seed to be sown after the first autumn rains—say, in the month of April, while the soil is comparatively warm. The conditions being favourable to germination, the plant will soon appear above ground, and will attain considerable dimensions before winter. During the winter months it will make considerable root-growth, and when the genial spring months come round, with refreshing showers of rain, it will start into active growth, and will soon give a good return. If the seed cannot be got in, say, during April or May, the months of June, July, and August should be passed over, and the month of September taken advantage of for spring sowing. The soil by this time will be getting a little warmer, and if the seed is sown on well-prepared soil, with genial showers, it will soon show above ground, and with a showery summer will do well. Should the summer, however, turn out a dry one, the plants will not have the same chance of withstanding the drought as the autumn-sown ones, not having developed so much root-growth. Where irrigation can be applied of course the crop can be relied upon to make the necessary root-growth, enabling it to withstand drought.

Quantity of Seed to sow per Acre.

Great diversity of opinion obtains, even among experienced men, with regard to the quantity of seed to be used per acre. Of course, soil, situation, and climatic conditions would influence this to some extent; but, all these being duly considered, opinions differ widely. I have put myself in communication with gentlemen in various parts of the Colony, experienced in this matter, with a view of arriving at some definite quantity to recommend, but while some recommend only 6 lb. per acre, others use as much as 25 lb. Now, as it is reckoned that there are 12,600 seeds in 1 oz., 25 lb. to the acre would give the enormous number of 5,040,000 seeds. This quantity appears absurdly large, and it would be simply impossible for the plants to have room to develop, as there would be fully 115 to every square foot. I have myself conducted numerous experiments with different quantities of seed per acre. On one occasion a 50-acre paddock was sown at the rate of 10 acres, 5 lb.; 10 acres, 10 lb.; 10 acres, 15 lb.; 10 acres, 20 lb.; and 10 acres, 25 lb. The conditions in all other respects, as to culture, &c., were identical. Of course the thickly-sown portion covered the ground soonest, and made the best show at first, but after the first year the plants seemed to be very much stunted, while the portions which received the 10 and 15 lb.

produced a fine, strong, robust, healthy plant, and remained longest in good condition. Since then I have always allowed 12 lb. of seed per acre, and on well-prepared soil I am quite certain this is about the happy medium. It is well known, however, that the plant has a tendency to thin out as it gets older; the strong plants get larger and kill out the weaker ones.

Treatment of Young Lucerne.

No heavy stock should be put on to lucerne the first season after sowing. Sheep may be put on occasionally, but not allowed to nibble the plants down bare, and a mowing machine should be run over it when it becomes spindly. It will branch out splendidly afterwards, on the same principle as do hedges or trees after having been pruned. At no time should it be eaten down too close. There should be at least three paddocks of lucerne if grazing is contemplated. A sufficient number of stock should be put on to eat the crop down quickly, then shift on to another paddock, and again to the third; by the time this is consumed the first paddock is fit for the stock again. Lucerne rebels against being continually nibbled at. As soon as the crop is eaten down it has a tendency to throw out shoots for the next crop. If the crown of a well-matured plant is examined it will be found that the new growth starts from the circumference of the woody crown, in delicate white shoots, and also from among the remains of old flower-stems. This means that as soon as the old growths are fed off the new growths start, and if the feeding is continuous they get trodden on and nipped off; being very soft when immature and full of sap, a serious bleeding takes place, and consequently injury to the plant. Sheep or any other stock may be grazed on lucerne if the above precautions are observed. There is no doubt the best results can be obtained by cutting lucerne and carting it to stock on what is known as the soiling system, but on a large scale this would not be practicable. As the word soiling is not generally well understood among our young farmers, a few lines here in explanation may not prove out of place. The system of soiling is described by a humourist as "grazing cattle in the house," and it really means cutting and carting the fodder to the animals. Several advantages are claimed for this system, the chief being (1) that a given extent of land will carry more stock; (2) that more actual food will be produced from such crops as lucerne; (3) that the food grown is more fully utilised; (4) that such animals as milch cows thrive much better and produce more milk; (5) that more and better manure is made. It will at once be seen that the cost of labour is very much greater than with grazing, but there are many circumstances under which the system may be pursued with excellent results, especially with milch cows. The system is most suitable for warm climates where forage crops grow easily, and where milch cows would suffer from the excessive heat of the summer or the cold bleak winds of winter. The system is gaining ground in some parts of the Colony. It is well known that in luxuriant pasture the animals destroy more than they consume.

Manure for Lucerne.

As leguminous plants are well known to obtain a considerable proportion of their nitrogenous food from the atmosphere, an application of this costliest of all manures would simply be money wasted.

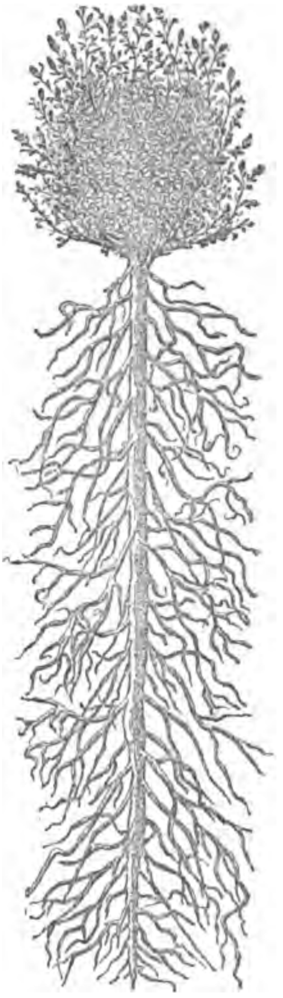
As a result of careful and successful experiments, I recommend a dressing of good superphosphate, 2 cwt., and kainit, 1 cwt.; the former supplying the phosphoric acid and lime, and latter potash. A top-dressing of gypsum generally proves highly beneficial.

The effects of Lucerne upon Soil.

The roots of lucerne strike 5, 10, 15, or 20 feet deep.

II.

G. VALDER.



A LUCERNE PLANT AND ITS ROOTS.
"Its long, heavy roots disturb the subsoil, push and crowd the earth this way and that, thus constituting a gigantic subsoiler. These roots become an immense magazine of fertility. As soon as cut, they begin to decay, and liberate the vast reservoir of fertilising matter below the plough, to be drawn upon by other crops for years to come."

WHEN first I went to the Riverina District, I was surprised to find that this grand forage crop was so little grown, and on asking some of the leading farmers and pastoralists for the reason, was informed that there was very little land suitable for lucerne growing in this district, the general opinion being that it would rarely, if ever, thrive well, except on the rich river flats. Feeling sure that this was a mistake, and believing that with proper cultivation this crop would be a very profitable one on almost any of the Riverina soils, I commenced a series of trials with the view of illustrating its value. The first plot tried was a great success, and I will, therefore, fully describe the system of cultivation adopted, so that others may benefit by my experience.

Of course, the farmer cannot always obtain a drill suitable for sowing lucerne seed, and therefore has to sow broadcast. In this case I would advise preparing the land as recommended below and sowing with a small broadcasting machine or by hand, at the rate of 4 to 6 lb. of seed per acre. At the same time, I would strongly recommend farmers to drill if possible.

Preparation of the Land.

There are certain soils, such as the light loams and deep rich river flats, in which lucerne can be grown with very little trouble, and the ordinary farmer requires but little instruction how to grow this crop in such soils. But the soil that I refer to is the stiff red loam, which is typical of millions of acres of the Riverina, and, therefore, is of interest to many. In order to grow lucerne to the best advantage on soil of this character, it is necessary to plough deep if the soil is deep, but if it is shallow it is better to plough, say, 6 inches, and subsoil another 6 or 8 inches. In my experiment the land was ploughed 10 inches deep. The land was then cross-harrowed, rolled, well worked with a spading-harrow, and finally carefully smoothed down with a light harrow. This brought the soil to a fine tilth, so that the seed was sown at even depth. Too much care cannot be given to this, for the finer the soil is the more even and heavy the crop will be. I would like to point out that it will pay a farmer far better to put in a small patch at a time, and put it in well, than it will to put a large crop in roughly, even if it takes him a year or so longer.

	s.	d.	
Cost of cultivation—Ploughing	12	0	per acre.
Harrowing, three times ...	3	0	„
Rolling, twice...	2	0	„
Spading-harrow, twice ...	2	0	„
Total	19	0	„

Sowing.—The seed was sown on the 6th June. I consider that May and June are by far the best months for sowing in Wagga district. During the winter months the plants will make little headway above ground, but they are making root-growth, and on the approach of warm spring weather grow very rapidly, and thus become well established before the hot weather sets in. They are thus able to stand almost any drought that is likely to be experienced here. The seed was sown in drills 14 inches apart by means of a machine drill.

This drill has eleven teeth, 7 inches apart; by shutting off every other feeder, six drills are sown 14 inches apart, and this is about as good a distance as it can be sown. By careful handling one man with a pair of horses can sow from 10 to 12 acres a day with this machine, using from 4 to 6 lb. of seed per acre. The expense of sowing is therefore per acre:—

	£	s.	d.	
Cost of seed (say 5 lb. at 10d.)	0	4	2	per acre.
Cost of sowing	0	1	0	„
	0	5	2	
Add to this preparation of the land	0	19	0	„
	£1	4	2	„

As the machine covers the seed sufficiently, no further expense is required, and therefore £1 4s. 2d. is the cost of putting in the crop.

Cultivation.

This is a very important item, as on it depends much of the success or otherwise of the crop. After the crop was well up, I stirred the soil between the drills with a machine hoe, which was set exactly the same as the drills, that is, 14 inches from the centre of hoe to centre of next hoe. This was done once when the crop was about 2 inches high, and again when it was about 8 inches high. It had the effect of killing all the weeds, and leaving the soil loose between the drills, thus taking every advantage of the least shower, and keeping the moisture in the soil.

Lucerne Paddock at Hawkesbury Agricultural College.

Another advantage which this system of cultivating lucerne has, is that sheep can be turned on to the crop, and after they are removed the land can be well stirred between the drills with the machine hoe; thus repairing any injury caused by the sheep tramping down the soil. Many pastoralists have written asking me to recommend a cultivator to loosen up soil after sheep have been on the crop. But this is not an easy thing to do, as there are really no machines that will stir a broadcast crop of lucerne without damaging it more or less. It is true that there are soils which can be worked up sufficiently by the use of a light harrow after feeding off, without appearing to cause much harm to the crop; but these soils are few and far between. As a rule the ordinary harrow damages the plants more or less, and in many soils does not stir sufficiently. I would, therefore, strongly recommend farmers and pastoralists who intend laying down large areas with lucerne to try sowing in drills and working between the drills as described in this article.

During the year five cuttings were taken off this plot of lucerne, the total yield being 10 tons 3 cwt. of green plant, or an average of a little over 2 tons per cutting. This means 3 tons of hay per acre the first year. The cost of taking the crop off and stacking would at most be 5s. per ton. The total cost of producing the crop would then be as follows:—

	£	s.	d.	
Cost of putting in the crop, including ploughing, harrowing, cost of seed, and sowing... ...	1	4	2	per acre.
Hoeing six times, at 1s. per acre	0	6	0	„
Taking off five crops = 3 tons hay	0	15	0	„
	2	5	2	„
Value of hay—3 tons at 40s.	6	0	0	„
Cost of production	2	5	2	„
				„
Profit for the first year	3	14	10	„

The actual profit on 1 acre of lucerne for the first year was thus £3 14s. 10d. As this year was the hottest and driest known for twenty years previously this result speaks for itself. Of course, during the second year the cost of production will be much lower, as the item, "cost of putting in crop," £1 4s. 2d. per acre is done away with; and surely anyone will acknowledge that lucerne always produces a much heavier crop the second year than the first, and we may therefore reasonably infer that the profits for the second year will be at least double that of the first.

No artificial watering was given, nor were any manures used. Numbers of farmers who saw this plot could hardly believe that such a good crop could be obtained simply by thorough cultivation of the soil. So convinced am I by this experiment that lucerne will grow successfully under the conditions described that I intend to carry out the next experiments on a much larger scale,—say in 20-acre plots—full particulars regarding which will be published in the *Agricultural Gazette* later on.

III.

Lucerne-growing for Pasture.

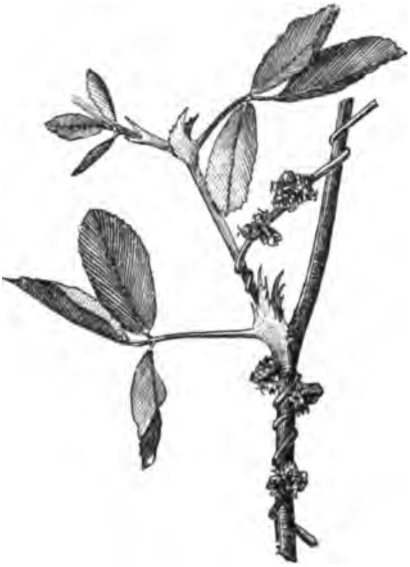
The following information on the above subject has been obtained through Mr. Inspector of Stock Watson, Corowa, at the instance of the Chief Inspector of Stock (October, 1896):—

The area laid down in lucerne in Corowa district is about 21,000 acres. The principal growers, with approximate area in each case, are:—H. Hay, Collendina, 7,000 acres; H. T. Whitty, Tarramia, 2,500 acres; A. Sloane, Mulwala, 2,000 acres; A. Hay, Boomanoomana, 3,000 acres; M'Farland Bros., Barooga, 3,000 acres; Hon. J. C. Wallace, Quat Quatta, 4,000 acres; also small lots at Merton Ball Plain and small holdings. Sandy soil, loamy, with clay subsoil, is the most suitable; but heavier land will carry lucerne with more seed. Plough 5 or 6 inches, but not deep enough to bring cold clay to surface. Harrow two or three times, as required. Sow when harrowing is fresh, and run over with brush harrow or bags nailed lengthways to a light spar. Most of the land in this district is dry-rung box forest. The cost of preparing the land is 8s. per acre without clearing. The clearing will depend on the timber and how long ringbarked. The quantity of seed per acre, the cost per lb., and the best kind—on this point there is a difference of opinion. Mr. H. Hay says 2 lb. per acre is enough. At Quat Quatta they put in 8 lb. I should say it in a great measure depends on the land. Cost per lb., 7d. Spring is the best season for sowing. The growing of lucerne is the greatest success. Fat stock, all through the lucerne, have been and are going from this district when there could have been none; besides the very much larger carrying capacity it has given to the holdings. Mr. H. Hay carries and fattens 40,000 sheep, 700 cattle, on 26,000 acres, of which only 7,000 acres are lucerne; and I could mention others. The crop has been unsuccessful only when put in in a very bad season. Lucerne wants a good season to start it. The first year's crop is stocked, but not too heavily. In some cases it is cut, and the stacks left on the paddocks, and at some portion of the year the stock prefer the dry to the green feed. I should always give stock on lucerne access to green leaves or pine. When well grown, if anything like a fair season, eight to ten sheep per acre may be pastured and fattened. How long before the land will require to be resown depends on how it is treated. If not overstocked, an indefinite period may elapse before fresh sowing will be necessary.

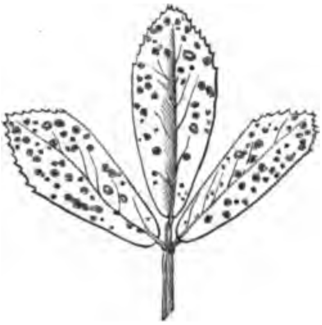
There will be a much larger average laid down every year, as not only the value is so much appreciated, but many owners who have let their land on the half system for wheat have made a condition that the last year the land should be laid down in lucerne. I consider there is a great future before us in this plant, and as it does not want much rain, from my experience of the pine scrub land on the Lachlan, I think it would do well there. Mr. M'Farland is sowing lucerne broadcast without any preparation. How this will do time will show. Sowing it with the wheat has been tried, but, so far as I can see, not with success.

Dodder.

The great enemy of the lucerne plant is the dodder (*Cuscuta epithymum*). The dodder seed is often sown with the lucerne seed, but can be removed by means of a sieve which has twenty meshes to the lineal inch. The dodder seed germinates same as the lucerne seed, and has a separate existence for a time, but, as the vine extends upwards, it clings to the lucerne with small sucking roots, which feed upon the elaborated sap of the lucerne plant. Thus it is a parasite of the worst kind. The lower part of the dodder-vine soon dies off, and thereafter it lives entirely upon the lucerne. The green leaves of the lucerne digest the food for the dodder; the latter has no leaves, only stem and flowers, and is of a beautiful golden colour. The dodder may be destroyed by spraying with a solution of sulphate of iron. The patches of lucerne which are infested should be mowed, and if the seeds are ripe, raked in heaps, and burnt on the ground.



Lucerne Plant, showing Dodder.



Lucerne leaf attacked by the fungus, *Sphaerella destructiva.*

A Disease of Lucerne.—*Sphaerella destructiva, B. and Br.*

The pustules or spots occur on nearly all parts of the host-plant, but are most conspicuous on the leaves, where they give rise, when numerous, to a decoloration. Plants attacked in this manner are recognised at a distance by their loss of colour.

This fungus is very destructive to lucerne at times, but is not known to attack other cultivated plants. There are two combative measures that may be profitably used:—

(1.) *Have a good System of Surface Drainage.*

It is well known that the growth of most fungi is accelerated by moisture on the surface of the adjacent ground and in the surrounding air, and *Sphaerella destructiva* is no exception to this rule. Good surface drainage will lessen both these promoters of the fungus.

(2.) *A rapid Succession of close Mowings.*

The principle of this remedy is very simple. The lucerne is to be cut so often that the fungus cannot get a good hold before the crop is again cut. This measure can be applied most successfully where the cultivation has been smooth.

The lucerne, when cut, should be removed from the paddock before it is quite dry, otherwise the leaves will fall off and remain to propagate the disease.

SORGHUM.

G. VALDER.

SORGHUM has proved to be a most valuable fodder-plant for the greater portion of New South Wales, yielding enormous crops of succulent forage even in dry seasons.

In most districts sorghum is sown broadcast at the rate of from 20 to 30 lb. per acre. The seed is usually sown from the end of September till January. In the hot dry districts it has been proved that sorghum can be best grown in drills. The drills are usually about 3 feet apart, and the seed is sown as thinly as possible in the drills. From 4 to 6 lb. of seed per acre is ample. As soon as the plants are fairly above ground it is advisable to stir the soil to a depth of 4 or 5 inches, and continue this at intervals of a month or five weeks. Of the numerous varieties I consider that Early Amber cane and Planter's Friend are by far the best for general feeding purposes. The following experiment will perhaps be of interest:—

From time to time the Department has received samples of sorghum seeds of different varieties from the various experiment stations in the United States. These were reported to be of superior value, both as to yield and quality, and in order that some idea might be formed as to their actual value in comparison with the varieties grown here, I obtained samples of seeds of the principal varieties grown in the colonies, and tested them side by side with the American varieties at Wagga.

The soil selected for the experiment was a fairly rich granitic loam, and being even in character right through the plots, it was a very suitable one for this test. It was deeply and thoroughly worked, being first ploughed 6 inches, then harrowed, cross-ploughed 6 inches, and finally brought to a fine tilth by working it with a cultivator. Land at all foul with weeds is unsuitable for sorghum, as the young plants, being feeble, are easily choked by weeds. Care was, therefore, taken to eradicate the young weeds before sowing.

The whole of the varieties were sown on the 9th October, 1894. The Planet Jr. No. 1 seed-drill was used, the seeds being sown in drills 3 feet apart, the young plants when about 3 inches high being thinned out with a small hand-hoe to about 4 to 5 inches apart in the drills. It is a mistake to grow sorghum closely, as experiments have proved that when it is sown too thickly the plants grow long and weak, and contain only a small percentage of sugar. I should strongly advise farmers to give careful attention to this matter when sowing broadcast. The seed was sown in this case at the rate of 9 lb. to the acre. At the time of sowing the soil was very favourable for germination, being warm and moist; as a result, nearly all the varieties were showing above ground in from four to five days.

The land was in a favourable situation, having an easterly aspect and being well sheltered from the westerly winds. This is very necessary when growing sorghum in drills, as in exposed situations the plants, which are easily blown down, will render cultivation between the drills a matter of great difficulty. Although the plants made a fair start their growth was afterwards much retarded by the dry, hot weather experienced here in November and the early part of December. A very noticeable feature during this period was that the variety known as "Dari" simply revelled in the heat, and while the other varieties scarcely made any growth, it grew

HOEING CROP OF "KAFFIR CORN" WITH HORSE HOE, WAGGA FARM.

rapidly, and six weeks after sowing was fully 5 feet high, none of the others having attained a greater height than 2 feet. This rate of growth, however, was not maintained, and during the showery weather at the end of December, several of the other varieties grew so quickly that they were soon as high as the "Dari." The only cultivation given after the plants were up was to stir the soil about once a month between the drills with a Planet Jr. cultivator, at first deeply, but when the plants were about 2 feet high, only shallow cultivation was given, so that the surface roots should not be injured. This stirring of the soil is a great help to sorghums in withstanding drought, as it keeps the moisture in the soil. None of the varieties were cut until they commenced to flower; this is a rule that, when possible, should be observed, as it is undoubtedly dangerous at times to feed cattle, especially milch cows, on sorghum in its young state. The first variety ready for cutting was the "Yellow Branching," which matured in eighty-seven days. Most of the varieties gave three cuttings during the summer, and had the weather not been so dry, no doubt from four to five cuttings would have been obtained. A collection of specimen heads of the varieties under trial was made up for exhibition at agricultural shows, each specimen being carefully mounted on a white board and labelled with name and yield per acre. This exhibit attracted much attention, and numerous inquiries were made as to the relative value of the different varieties shown. In comparing specimens of sorghums grown in all parts of the Colony by exhibitors with those from Wagga, it was seen that the different varieties had remained very true, scarcely a single specimen showing any sign of crossing, although farmers assured me some of these varieties had been grown side by side for years. In some instances farmers were growing Planter's Friend (brown seed), Sorghum saccharatum (black seed), the Kaffir Corn (white seed) in the same paddock, and yet each variety remained true. I have often heard farmers speak of sorghums crossing, but I do not believe that, as a rule, they will cross, only in very exceptional cases.

The following table will show the yield of green fodder per acre:—

Name of Variety	Obtained from—	When ready to cut. No. of days from time of sowing.	Height attained.	Yield.			Total yield for the Season.
				1st cutting.	2nd cutting.	3rd cutting.	
			ft. in.	t. cwt.	t. cwt.	t. cwt.	t. cwt.
Early Amber Cane	Anderson, Sydney	112	7 0	12 19	5 3	3 4	21 6
Planter's Friend	„ „	134	7 6	13 3	3 15	2 18	19 16
Black African	U.S.A.	118	8 0	11 6	4 13	2 17	18 16
Undendibule	„	129	8 0	11 14	4 2	2 8	18 4
Dari	India	99	6 0	11 6	4 13	1 8	17 7
Coleman	U.S.A.	129	7 0	11 2	3 17	2 1	17 0
McLean	„	139	7 0	10 8	4 9	1 7	16 4
Chinese Cane	„	137	9 0	10 3	3 14	1 18	15 15
Red Liberian	„	140	7 6	12 2	3 7	....	15 9
Early Orange	Law, Somner, & Co., Melbourne.	142	6 6	10 3	4 1	....	14 4
Black (Sorghum saccharatum) ..	Anderson, Sydney	125	7 6	7 2	4 6	2 13	14 1
Dhoura or Guinea Corn	Law, Somner, & Co.	144	5 0	10 13	2 5	....	12 18
Red Kaffir Corn	U.S.A.	141	4 0	8 17	3 18	....	12 15
White Kaffir Corn	Law, Somner, & Co.	119	3 6	7 11	3 10	1 7	12 8
Yellow Branching	„ „	87	4 0	6 5	2 17	1 16	10 18
Brown Dhoura or Egyptian Corn	„ „	94	4 0	4 1	2 9	1 9	7 19

Early Amber Cane.—This variety, which is a rather quick-growing one, is certainly the best all-round sorghum of those tested. The stalks are thin and numerous, and are well covered with foliage. It evidently is rich in sugar, as cattle greedily eat up every particle of leaf and stalk. Although not producing the heaviest first crop it yielded such heavy second and third cuttings as to place it at the head of the list.

Planter's Friend.—A good all-round variety, slower in growth and coarser in the stalk than Early Amber. Yielded the heaviest first crop of all, but did not stand the hot dry weather so well as some of the other varieties, and, therefore the second and third cuttings were not so good as those of several of the other varieties.

Black African.—The best of the American varieties, producing a crop of fine rich foliage much resembling Early Amber Cane. This variety is, certainly a valuable addition to our sorghums, and is worthy the attention of sorghum growers. It was introduced from America by this Department together with the M'Lean, Coleman, and Collier varieties, being obtained from the Department of Agriculture, Washington.

Undendibule.—Another American variety of first-class quality, but slower in growth than Black African, and coarser in the stalk.

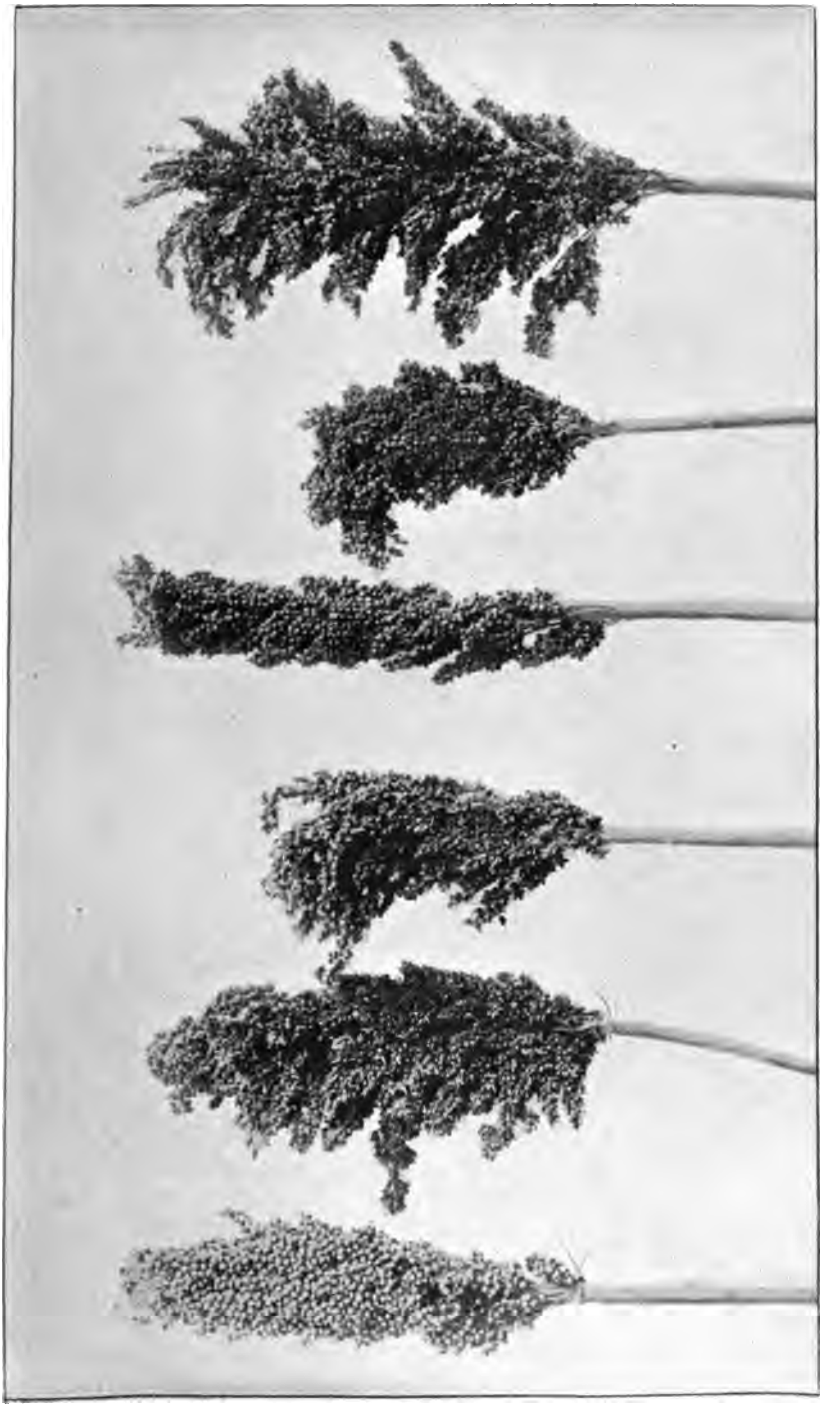
Dari.—This variety, although giving a heavy yield, is not nearly so valuable for forage as the above varieties, as it is very coarse in the stalk and evidently is low in saccharine matter. Unless cut young the cattle will not eat the stalks, but pull off the leaves and tops and trample the stalks under foot. Its great value is for the seed, which it yields very heavily, and also for its drought-resisting qualities.

YIELD OF SEED.

Variety.	Yield per acre Bushels of 60 lb.
Yellow Branching	48
Dari	46
Planter's Friend	43
White Kaffir Corn	43
Red Kaffir Corn	41½
Brown Dhoura or Egyptian Corn	40
McLean	39
Early Amber Cane	38½
Dhoura or Guinea Corn	38
Black African	36
Early Orange	35
Undendibule	35
Chinese Cane	33
Black (sorghum saccharatum)	32
Coleman...	30½
Red Liberian	28

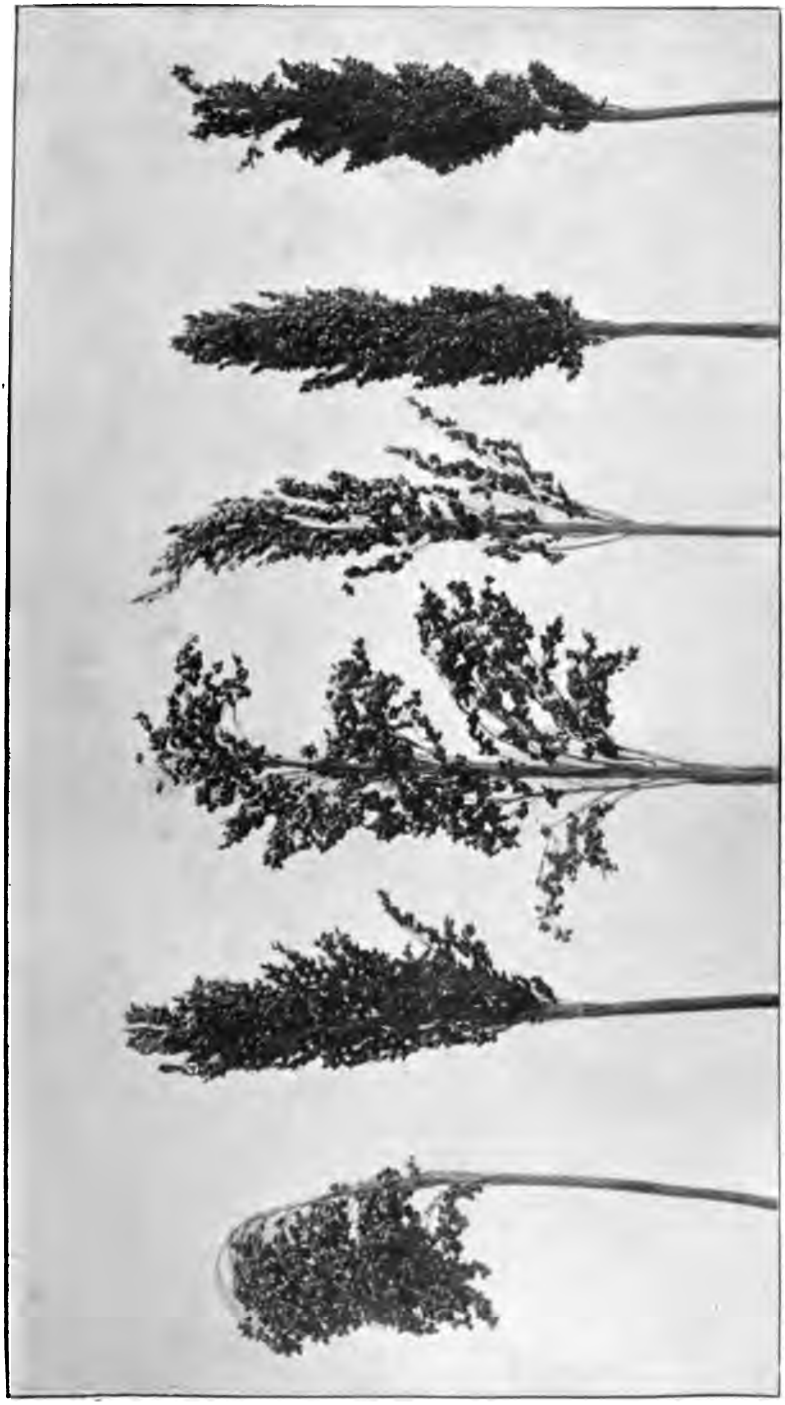
On referring to the two tables, *i.e.*, "yield of forage" and "yield of seed," it will be seen that the quick-growing dwarf varieties, as a rule, produced by far the heaviest crops of seed. This especially applies to the "Yellow Branching," "Brown Dhoura," "Dari," and "Kaffir Corn" varieties. This result leads me to think that these varieties should be of great value for pig-feeding, and I can strongly recommend farmers who intend to go in for pig-raising, on a large scale, to give them a trial, especially the "Yellow Branching" and "Brown Dhoura" varieties. These two varieties will, under favourable conditions, mature their seed in from three to four months. They grow only about 4 feet in height, and are much branched. A number of the heads hang over *vide* illustrations (Plates I, II, III); this is, no doubt, caused by the great weight of seed in the heads being too heavy for the stalk. These varieties

PLATE I.



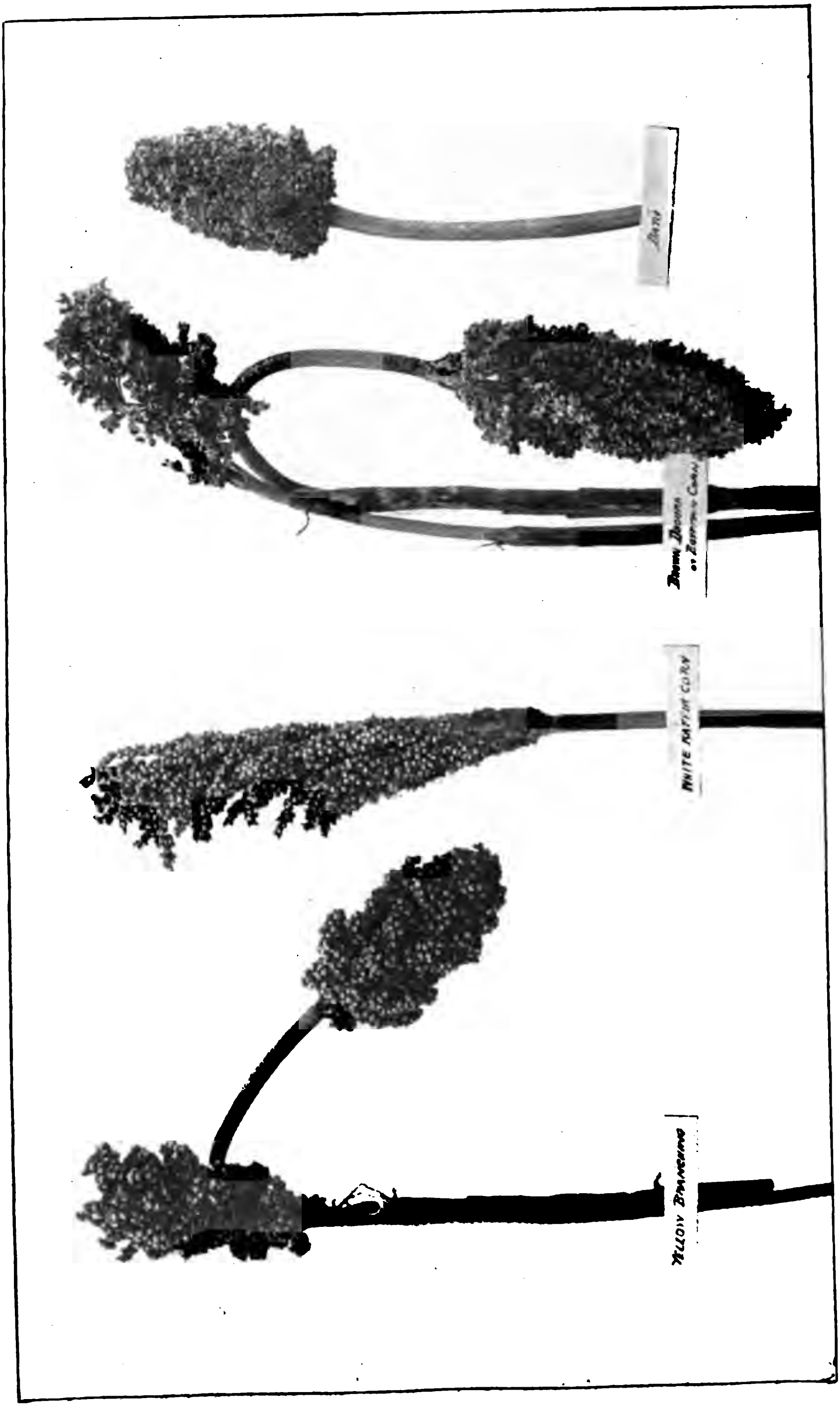
TYPICAL HEADS OF VARIETIES OF SORGHUMS GROWN AT WAGGA.

PLATE II.



TYPICAL HEADS OF VARIETIES OF SORGHUMS GROWN AT WAGGA.

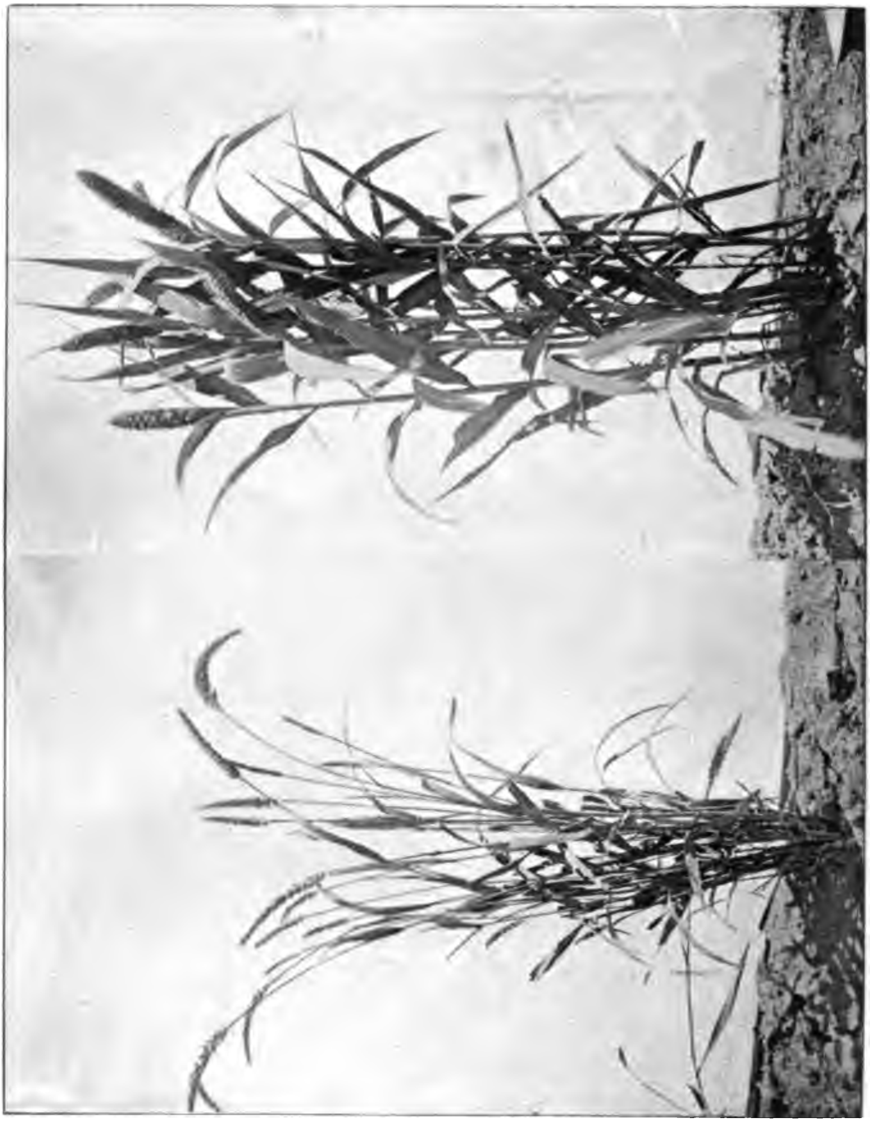
PLATE III.



TYPICAL HEADS OF VARIETIES OF SORGHUMS GROWN AT WAGGA.

Pearl Millet.

EXPERIMENT FARM, WAGGA.



Hungarian Millet. Salzer's Dakota Millet.

WAGGA EXPERIMENT FARM.

would pay to cultivate for their seed alone, sorghum seed being of about the same feeding value as maize. They are also good varieties to grow for poultry-food. The variety known as "Dari" is largely grown in India and Egypt, and the seed is exported to London, where it is sold for pheasant, partridge, and poultry feeding to owners of large shooting reserves. I have also heard of its being bought up in large quantities for the purpose of adulterating oatmeal, cornflour, and other farinaceous foods.

The American varieties under trial were imported some two years ago; the seed being distributed to a number of farmers in various parts of the Colony. For the seed used for these tests I am indebted to the following gentlemen:—Messrs. J. Hayter, Camden; M. Waters, Richmond; and D. Manson, Albion Park.

MILLETS.

SPLENDID crops of these fodder plants have been grown at the different experiment farms. Millet is sown like sorghum, 12 lb. to 15 lb. of seed per acre broadcast, 10 lb. drilled.

At Wagga Wagga a series of tests were made during the season 1895–6, with the following results:—

YIELD OF GREEN FODDER PER ACRE.

Name of Variety.	1st cutting.		2nd cutting.		3rd cutting.		Total.	
	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.
German, Salzer's Dakota	5	13	2	19	2	1	10	13
Hungarian	4	3	1	13	1	4	7	0
Golden Wonder	3	17	1	10	0	18	6	5
Yellow	2	14	....		....		2	14
Red or Millet Sanguin	2	6	....		....		2	6
Pearl	12	9	3	17	2	1	18	5
White French	2	18	....		....		2	18

YIELD OF SEED PER ACRE.

	Bushels of 60 lb.
White French	44
Golden Wonder	37
Yellow	29
Hungarian	24
Salzer's Dakota	22½
Pearl	22
Red	17

Mr. M'Keown, manager of the Wollongbar Experiment Farm, makes first-class chaff from the Hungarian millet hay, and a large number of farmers in different parts of the Colony who have tried millet hay and chaff report favourably regardiug it.

RAPE.

BY J. L. THOMPSON.

THE rape plant is a native of Europe, perhaps of England, but it is hard to say where it is actually indigenous and where naturalised. It bears a close resemblance to Swede turnip in the early stages of its growth, but usually attains a greater height than the turnip, and produces more of stem and leaves. It has a fusiform and stringy root, while that of the turnip is bulbous. On average soils, when grown in drills, it usually reaches a height of from 18 to 20 inches, but on soils very rich in vegetable matter it sometimes attains a height of between 2 and 3 feet.

There are several varieties of rape, but the only kind I have had any experience with as a pasture is known as the dwarf Essex.

Like the turnip, rape is adapted to temperate climates. It prefers to grow in temperatures that are cool rather than warm. In New England and other cool regions of this Colony it will grow best during the summer months, but on the Hawkesbury, and in all warm regions, it will grow best during the winter months. The most suitable soils for growing rape are fairly-moist free-working loams, rich in organic matter. Black loams are also suitable, containing, as they generally do, a large amount of humus. Good maize, potato, or turnip land will grow rape. It will also grow on clay soils after the plants get a start, but not so luxuriantly as on the other soils I have mentioned. Rape as a rotation crop cannot, in my opinion, be excelled. I have had wonderful results with the crop in recuperating old worn-out wheat land in South Australia.

At Dookie I had a similar experience. There, a paddock of 40 acres which in 1886 had been sown with wheat, was not worth cutting, so poor had the returns become from continued cereal growing. In January of the year following I ploughed the land deeply, and exposed the soil to the ameliorating influence of the hot summer sun. Towards the end of March I had it thoroughly cultivated fully 6 inches deep with scarifier, disc harrow, ordinary harrows and roller, until it was brought to a tilth equal to the proverbial "onion bed." Early in April, and just after the first autumn rains, with sufficient moisture to ensure the rapid germination of the seed, I sowed the rape broad-cast, at the rate of 6 lb. to the acre on the finely-harrowed surface. To cover the seed, I simply passed the roller over it. This, I may say, is sufficient covering, the smaller seeds if buried too deeply do not germinate, and the seedsman is blamed unjustly. Nature sows her seeds very shallow, and they germinate and grow well, especially if they are not wanted to.

The plants appeared in less than a week, and the rough leaf in a fortnight. Owing to the moisture and warmth at that season of the year, it grew like magic, and by the end of May was fit for the ewes and lambs. Over twelve head per acre were pastured on this rape, besides numerous milch cows and other cattle, until January, 1888, when the residue, with all the sheep droppings, was ploughed under, but not too deeply. The land was allowed again to sweeten for a few months, and the vegetable matter to decompose. It was next sown with "Chevalier" barley, in the proportion of 1 bushel to the acre—this was towards the end of April The yield was 25 bushels to the acre of a magnificent sample of malting barley, which was sold for seed at 6s. 6d. per bushel. This prosperous result was gained in a season when the rainfall for the whole year was only 14·51 inches.

In the following year this land was again sown with "Chevalier" barley, and produced a prime sample, which yielded 20 bushels to the acre. In 1890 I sowed this land with Cape barley, oats, a little rape, vetches, peas, and beans for an ensilage crop, and secured a yield of fully 10 tons to the acre of prime succulent herbage. This was cut in November, the land was manured with farm-yard compost, and immediately sown with sorghum, which yielded in the following February 15 tons, being 25 tons per acre of sow feed in a dry district.

But to return to rape. I have secured better results by sowing it in drills, and, when the ground requires cleaning, this is the best method of cultivation. When drilled in from 1½ lb. to 2 lb. of seed to the acre will be sufficient, but when broad-casted, 5 lb. to 6 lb. will be necessary. The seed can usually be purchased at 3d. per lb., so that the cost of the seed is very small.

When sown in drills, as the rough leaf appears on the plant, the horse-hoe should be freely used between the rows to keep down the weeds, and to keep the soil open and loose, fracturing the capillary tubes which bring the moisture from the lower strata, and caused to be dissipated into vapours in the air. No attention need be given to thinning. Rape being an excellent cleansing crop when grown in drills and cultivated, it may, with advantage, be grown between two crops of grain.

Rape can also be grown as a catch crop, *i.e.*, as soon as a cereal crop is removed, if the land is not too stiff, the stubble land may be simply scarified, harrowed, and brought to a fine tilth, and the seed sown. The crop may be either pastured or ploughed in as green manure.

It makes a capital soiling crop. The crop can be cut down and fed to cows or other animals in a shed, or scattered over a small paddock or yard. But it is as farm manure that rape is of so much value to the Australian farmer in recuperating his worn-out, wheat-sick soil.

The plant contains about 8 per cent. of carbo-hydrates, 2 per cent. of albumen, and a little fat. It cannot be excelled for fattening old ewes, or producing fat lambs for the market. When very young and succulent rape is liable to scour sheep; to prevent this, a little hay or straw chaff should be within reach of the animals to counteract this tendency.

In New Zealand and Canada half a pint of oats per sheep is allowed, with very payable results. Rock salt, in all cases, should be within reach of the sheep.

Rape is not suitable as a food on which to feed milch cows exclusively, as it taints the milk. It is, however, capital food for pigs, and they are very fond of it.

Fertilizer for Rape.

Although rape will give a profitable return during an average season on fair land, thoroughly cultivated, without manure, it is responsive to an application of farm-yard manure. It is probable that the application of a complete fertilizer will give satisfactory results.

From experiments carried out with fertilizers applied to this plant, at the Ontario Agricultural College Experiment Station, Canada, the best results were obtained from the application of nitrate of soda, and the next from the application of salt.

Precautions to be observed in feeding with Rape.

Stock should never be turned into rape when hungry—otherwise they will eat too much of it and become blown, and probably a large percentage may die.

I have been very successful with cattle and sheep, when first put on to succulent herbage, by simply putting them on with full stomachs, and then leaving them there. Owners of pure bred pedigree stock should use great care when pasturing valuable animals on rape.

In my opinion there is great room for the extension of the rape industry in Australia. One acre will fatten ten lambs. I know of no other plant of the same importance so likely to assist to develop and fatten a cross-bred or long-woolled sheep suitable for the English market. In this respect rape is much superior to turnips, inasmuch as it will grow in many parts of New South Wales where turnips would fail.

Further particulars concerning this crop are given on p. 89.

THOUSAND-HEADED KALE AND JERSEY TREE KALE.

THE thousand-headed kale differs from the Jersey tree kale in its more dwarfed habit of growth, its stems being divided into a number of leafy branches, and its leaves not being quite so large. It is, however, considered to be more productive to the given area.

" Plots of these two kales were sown in March, 1895 and 1896, and much to my astonishment, some remarkable yields were obtained from them. They resisted the dry weather, and made an enormous growth, as will be seen in *Agricultural Gazette*, September, 1896. I have never at any time advocated growing these plants in any other part of the Colony than the colder portions of the tablelands and the South Coast district, *i.e.*, in cool, moist climates. I was, therefore, surprised to find that during the past hot and dry summer, they yielded a heavy crop without the aid of irrigation. Although several cuttings have been made from the plants grown from seed sown in 1895, they are still strong and healthy, and continue to produce heavy crops of leaf. I would strongly urge pastoralists to try these plants for " topping off" sheep, a purpose for which large areas of this crop are devoted to in England. They are also valuable for cattle feeding."—(*G. Valder.*)

A deep well-tilled loam will suit this plant admirably, and if the land is adhesive, even inclining to clay, so long as it works freely, there are the conditions for a grand paying crop to start with. Speaking generally, it may be said that the lighter the soil the greater need for abundant manuring, and the stiffer the land the more the necessity for deep tillage and thorough cultivation, to give the roots ample opportunity of ramifying freely. From twenty to thirty loads per acre of good farm-yard manure will not be too much for this crop. Where farm-yard manure is not available, the following proportions of artificial can be recommended per acre:—Sulphate of ammonia, 1 cwt.; kainit, 3 cwt., super-phosphate of lime, 3 cwt. The kainit and super-phosphate of lime are best applied mixed at the time of sowing, but the sulphate of ammonia must not be combined with the other manures. The last-named article should be got in separately before drilling in seed or transplanting, and, if possible, just prior to a fall of rain.

Transplanting.

A dull or showery day should be selected for transplanting. Allowing 30 inches apart each way, about 7,000 plants will be required per acre. It will help to give them a start if the roots are dipped in a thick puddle, consisting of a mixture of soil and artificial manure, with only sufficient water to render the mixture adhesive. As a rule, the holes are best made with a dibber, and care should be taken to put the plants in perfectly straight. If the roots are doubled up, ill-formed specimens will be produced, or the plants may fail altogether. The soil must be closely pressed round the neck of the plant as a finish to the operation. The ground should be kept free from weeds, either by hand-labour or the horse-hoe.

Seed-bed.

Should the seed-bed be decided on, make the soil thoroughly rich and friable, so that when the young plants are drawn from it, the fibrous roots may be as little injured as possible. Sowing in rows is desirable, for the crop can then be kept clean, and is altogether more manageable than when the seed is sown broadcast. From the outset every plant must have space enough to make a stocky growth, or the seedlings will be leggy, and never afterwards develop into the splendid proportions attained by plants that have been short and stout from the commencement.

Culture.

There are two modes of cultivating kale—(1), by drilling in the seed where the crop is to grow, and (2), by raising plants in a seed-bed, and transplanting. The former practice requires from 4 to 6 lb. of seed per acre; for the latter purpose, 1 lb. is sufficient. A smaller quantity would answer for drilling, if every seed were certain to be in the right place, and the young plants had no enemies. The cost of seed is greater for the drill than for the seed-bed, but this difference is more than neutralised by the additional expenses which the transplanting system entails, to say nothing of the loss which is involved in seriously checking the growth of the plant. The saving of labour effected by the drill is alone a very considerable item, therefore, we unhesitatingly advise the practice of drilling. The seed should be drilled in rows 30 inches apart, and when the seedlings are well above ground they should be thinned out to 30 inches apart in the rows.

Feeding Value.

Analyses show that the cabbage family contain nourishing constituents to the extent of 6 per cent. of carbohydrates, over 1 per cent. of albumen, and very little fat. The stalks are richer in these elements of plant food than the leaves; also, that young plants are more nutritious than old plants; the outer leaves are better food than the inner leaves or hearts; and, weight for weight, the open-leaved varieties (kales) are preferable to the hearting cabbages. It has been proved by experience that cows increase their milk wonderfully when fed with thousand-headed kale.

The following is an extract from Mr. Russell's paper:—"Thousand-headed kale is the least known and most desirable of any green crop I have ever seen. It is a plant that produces more feed per acre than any other, does not disagree with any stock, and does not impoverish the land. With me it has never caused sheep or lambs to blow or scour. Eighteen perches per day, with a little oat straw, have kept 270 sheep for three months, without the loss of one."

GRASSES AND CLOVERS.

THE laying-down of pastures is touched upon by Mr. Bruce in the chapter on crossbred sheep, page 83.

The native grasses and forage plants are so numerous and of such importance as to render anything like adequate treatment impossible in the few pages available in a book like this. Mr. Fred. Turner, late Botanist to the Department, has dealt exhaustively with the subject in his "Forage Plants of Australia" and "Australian Grasses," each comprising nearly 100 full-page plates and full descriptions of the plants and grasses. These works were published by the Department of Agriculture, and can be obtained at the Government Printing Office, Sydney, where also Mr. J. H. Maiden's recently published "Manual of Australian Grass" may be had.

MISCELLANEOUS FORAGE CROPS.

G. VALDER.

SALTBUSH.

FROM the commencement of my residence at Wagga Wagga I became convinced that there was a great work to be done in bringing saltbush of various species into cultivation on a large scale, and I at once turned my attention to them. At first I found great difficulty in getting a start, as consignments of plants from the far west had in nearly every instance sweated, through bad packing, and therefore were valueless. Since then, however, I have managed to get some few plants to grow, and from these I have propagated a large number by cuttings. Small beds have been sown with seeds of different species, and the plots are steadily increasing, until now there is every prospect of my soon having a number of species covering fairly large areas. The following are the kinds experimented with.

Atriplex nummularia, Linn.—"**Old Man Saltbush.**"

Seeds and cuttings were tried, the best results were obtained from seeds sown in autumn, and cuttings planted out at the same time. The seeds were sown in beds, and the young plants transplanted out when about 5 inches high into a large plot of well worked sandy soil. They were put in drills 4 feet apart, the plants being 2 feet apart in the drills. When they had made a strong growth I took out every other one, thus making them 4 feet by 4 feet. I find that this is quite close enough, for in ten months the plants were 6 or 7 feet high and touching. Another large plot was sown broadcast, and the seed raked in, but although I obtained a number of plants, I do not consider this a good plan as the saltbush seeds are slow in germinating, and the plots get covered with weeds. I am afraid that this slowness of germination will much retard any attempts at cultivating saltbush on a large scale, and I would advise sowing in seed beds and transplanting. Although this is a slow process it will pay well. Sowing seed in drills was tried, but this also was not a success.

Propagation by means of cuttings was very successful. Medium-sized wood, about 12 to 15 inches in length, was used. The cuttings were planted in drills the same distance apart as the young plants, *i.e.*, 4 feet by 2, and every other plant in the drill removed when they had made a fair growth. They were put in about 6 to 8 inches deep, and the soil was then pressed tightly round them. If this system is adopted in showery weather in the autumn, there is every prospect of success, and large areas can thus rapidly be planted out. From twenty-five to thirty plants, twelve months old, produce sufficient cuttings to plant an acre.

PLANT OF OLD MAN SALTBUSH (ATRIPLEX NUMMULARIA) TEN MONTHS OLD.

Atriplex halimoides, Lindl.

This species is of a dwarf-growing habit, and it does not require so much room as the "Old Man." Seed-beds were sown in the autumn, and plants transplanted early in spring; they grew very luxuriantly, and produced an enormous crop of seeds. These seeds blew over a large tract of cultivation, and since then I have noticed them growing in all sorts of situations, thus proving how well they are suited to this district.

Atriplex leptocarpa, F.v.M.

Seeds of this species were also sown in seed-beds and transplanted. It is of a creeping nature, and does not grow so strongly as the former, although appearing to thrive well. It has not seeded yet, but will, I think, soon produce a heavy yield of seed.

Atriplex semibaccata, R. Br.

This species was only received this last autumn, but the young plants are growing very strongly, and, I believe, it will prove one of the best of the dwarf-growing saltbushes.

Rhagodia hastata, R. Br.

Young plants and cuttings were received and planted out at different times. They have all done well, and a large number of cuttings have since been taken from them and set out. So easily can they be propagated that there is no reason why this species should not be grown in large areas. The smallest cutting will grow, and with little or no trouble. The following illustration shows the growth from a cutting in six months.

Single Plant of Rhagodia hastata Six Months after Planting Cutting

Kochia aphylla, R. Br.—"**Cotton Bush.**"

A few plants of this species were received, but only one grew. This is, however, growing strongly, and will no doubt produce sufficient seed from which to raise a large number of plants. Pastoralists who have had experience with this plant, say that it is one of the very best of saltbushes, and, therefore, I shall endeavour to obtain a large supply of seed and plants.

The general idea seems to be that saltbush will not thrive in any soils except those containing a heavy percentage of salt. But so far the trials at Wagga Wagga prove the opposite, as several of these species have been grown here now for two years, and after three or four cuttings are growing stronger than ever.

It is to be hoped that pastoralists will take every precaution to prevent the extinction of these valuable fodder plants. A small area could be enclosed as a nursery at small expense, and from it abundant cuttings would always be available for replanting paddocks that have been eaten out.

REPORT ON THE FODDER VALUE OF SALTBUSH.

BY F. B. GUTHRIE, Chemist.

THE value of saltbush as a fodder is too well known to require special reference at this time of day.

The main object of the following analyses was to compare the feeding-value of the plant in its native state in different parts of the Colony, with one another, and with the plant grown as a cultivated crop. For this purpose, Mr. George Valder kindly supplied me with a sample of *Atriplex nummularia* (Old Man Saltbush), grown by him at Wagga.

This is compared in the following table with a specimen of the same plant (uncultivated) from Bourke.

All the plants referred to were named by my friend, Mr. J. H. Maiden, Director of the Botanic Gardens. Unfortunately, the identification was not, in all cases, possible, owing to the absence of fruiting specimens. Of the first pair, however, there was no doubt.

	A. nummularia. Grown at Wagga. (Under cultivation.)	*A. nummularia.* From Bourke. (Uncultivated.)
Moisture	75·11	56·73
Oil	·56	·67
Digestible fibre	8·21	11·59
Woody fibre	3·29	3·93
Soluble albumenoids	·50	1·76
Insoluble albumenoids	2·56	3·54
Soluble ash	5·77	14·14
Insoluble ash	·15	2·04
Chlorophyll, amides, and other extractives (by difference)	3·85	5·60
	100·	100·
Total nitrogen	·74	1·20
Amide nitrogen	·25	·36
Percentage of common salt in ash	36·6	56·6

The great difference in the percentage of moisture is due to the fact that the Wagga specimens had not so far to travel, and were more carefully packed.

In order to obtain a fair comparison, the above table is calculated to dry substance, as follows:—

COMPARISON of cultivated and uncultivated specimens of *Atriplex nummularia*—Calculated to dry substance:—

	A. nummularia. Grown at Wagga. (Under cultivation.)	*A. nummularia.* From Bourke. (Uncultivated.)
Oil	2·25	1·54
Digestible fibre	32·98	26·78
Woody fibre	13·21	9·08
Soluble albumenoids	2·01	4·06
Insoluble albumenoids	10·28	8·19
Soluble ash	23·11	32·68
Insoluble ash	·60	4·71
Chlorophyll, amides, and other extractives (by difference)	15·56	12·96
	100·	100·
Total Nitrogen	2·97	2·76
Amide „	1·01	·80

The most striking differences here are the larger proportion of oil and digestible fibre in the cultivated specimen, and the lower proportion of ash.

Particularly remarkable is the diminution of common salt in the cultivated sample.

The nitrogen compounds are more abundant in the Wagga sample, but an exceptionably large proportion is present as insoluble albumenoids.

Nearly 95 per cent. of the ash in the Wagga sample is soluble in water as against 85 per cent. in the Bourke sample.

The following table shows the comparative composition of samples of saltbush from Bourke and Hay respectively:—

The names and locality of the specimens are as follows:—

A. *Atriplex nummularia*, from Bourke.
B. *Rhagodia parabolica*, „
C. *Atriplex halimoides* (mixed with another species of *Atriplex*), from Bourke.
D. *Rhagodia Billiardieri* (probably), from Hay.
E. *Atriplex angulata*, from Hay.
F. Unidentified, from Hay.

Analyses of Saltbush from Bourke and Hay, calculated to dry substance.

	A.	B.	C.	D.	E.	F.
Oil	1·54	2·06	2·10	1·88	3·27	1·83
Digestible fibre	26·78	22·17	23·06	18·91	10·20	26·99
Woody fibre	9·08	18·68	13·45	11·01	21·87	12·27
Soluble albumenoides ...	4·06	3·56	2·92	5·46	3·04	3·86
Insoluble albumenoides...	8·19	6·93	3·56	8·53	2·91	5·97
Soluble ash	32·68	24·68	26·78	30·64	29·15	28·75
Insoluble ash	4·71	5·81	3·83	3·90	19·49	4·84
Chlorophyll, amides, and other extractives (by difference)	12·96	16·11	24·30	19·67	10·07	15·49
	100·	100·	100·	100·	100·	100·
Total nitrogen ...	2·76	2·60	2·48	3·66	1·84	1·95
Amide „ ...	·80	·92	1·44	1·42	·89	·58
Percentage of common salt in ash	56·6	44·7	59·5	44·3	49·9	59·7

The amount of water in the different samples examined was, as has been said, extremely irregular, some of the samples having become very dry in transit.

The percentages of water were as follows:—

A	56·73	D	63·41
B	41·86	E	38·64
C	40·48	F	50·88

The percentage of water in fresh saltbush is as high as 75 or over (see Wagga specimen).

It will, therefore, be seen that some of the above had lost a considerable proportion of their water, especially the smaller-leaved varieties.

It is noteworthy that the samples containing the largest proportions of water are the highest in nitrogen and albumenoids.

The amounts of soluble to insoluble albumenoids are in the proportion of 1 to 1½ or 2, except in the case of *A. angulata* from Hay, in which they are about equal.

This specimen is exceptional in other ways, notably in the large percentage of ash and the high proportion of ash insoluble in water, nearly half the total amount being insoluble in water in this sample, whereas in the other cases about one-eighth only of the total amount of ash is insoluble.

The above method of stating the results of analysis has the advantage of showing the proportion of the different constituents which are soluble or not and the amount of digestible fibre.

Unfortunately I am not able to lay my hand on many analyses of other fodders stated in the same way. The following analysis of a sample of hay from English meadow grass made in the laboratory of the Royal Agricultural Society of England and of a sample of *Paspalum dilatatum* hay, which is known locally as an excellent fodder, will serve to show the essential differences between the grasses and the saltbushes. These are also calculated to dry substance.

	Hay from English meadow grass (*Addyman*).	Hay from *Paspalum dilatatum.*
Digestible fibre	33·35	33·49
Woody fibre	26·65	31·35
Soluble albumenoides	1·14	1·54
Insoluble albumenoids	9·17	9·98
Soluble ash	2·55	4·83
Insoluble ash	5·42	2·29
Chlorophyll, amides, &c. (by difference)	21·72	16·52
	100·	100·
Total nitrogen	1·79	2·97
Amide nitrogen	·14	1·18

The striking difference between the saltbushes and the two fodders here compared is the very high percentage of saline matter (ash) in the saltbushes; they are correspondingly lower in fibre, and the amount of digestible ingredients is much higher. Their value as a fodder is therefore considerably higher.

Although this way of tabulating the results of analysis of fodder is in my opinion preferable to the shorter method usually adopted, it will nevertheless be advisable to express the results in the ordinary way in order to compare the composition of these saltbushes with the more ordinary fodder-plants, as it is difficult to get a sufficient number of results stated in the above form, whereas the analyses of fodders usually published (giving only the amounts of albumenoids, carbohydrates, fibre, and ash) are numerous and easily accessible.

For the sake of brevity only the mean of the analyses of the Bourke and Hay saltbushes will be given, and to avoid the discrepancies occasioned by the different degree of freshness of the samples, I have calculated all out on the basis of 75 per cent. water, which fairly represents the composition of fresh saltbush.

	Average of 3 samples from Bourke.	Average of 3 samples from Hay.	Sample from Wagga.
Water	75·00	75·00	75·00
Oil...	·47	·61	·56
Albumenoides (N x 6·25) ...	2·37	2·52	3·07
Carbohydrates	10·55	7·78	12·13
Woody fibre	3·52	3·98	3·30
Ash	8·09	10·11	5·94
	100·	100·	100·
Percentage of common salt in ash	53·06	51·03	36·06

The following gives for comparison the composition of some ordinary green fodders taken from Messrs. Jinkins and Winton's table, page 126:—

	Maize—Fodder.	Sorghum.	Lucerne.	Timothy Grass.
Water	79·3	79·4	71·8	61·6
Oil	·5	·5	1·0	1·2
Albumenoids	1·8	1·3	4·8	3·1
Carbohydrates	12·2	11·6	12·3	20·2
Woody fibre	5·0	6·1	7·4	11·8
Ash	1·2	1·1	2·7	2·1

A comparison of the above shows that the saltbushes take a high place amongst green fodders, the amounts of carbohydrates and albumenoids being high, and the woody fibre relatively low.

The high content of mineral matters, especially of common salt, is of course characteristic.

In discussing their merits as fodder, it must not be forgotten that they possess natural advantages over the ordinary cultivated crop or pasture grasses. They flourish on land which will not support other nourishing plants; they resist drought to an exceptional degree; are indigenous and require no cultivation; are relished by stock, and are exceedingly prolific and easily propagated.

It would appear, however, in spite of the universal recognition of these facts by stock-owners, that there is some danger of these plants becoming less abundant than formerly, through overstocking and other causes. I have repeatedly heard stock-owners and visitors in the west during the recent severe drought lament this fact.

It seemed, therefore, that this is the proper time to call attention once more to the high nutritive value of these plants in the way I have done, by careful analysis and comparison with other fodder-crops.

In California they have imported a number of species from Australia for the purpose of experimenting with it on the alkaline soils of that State.

Here is what Professor Wickson says of ***Atriplex semibaccata***, the variety which has shown the most successful results in California.

"*A. semibaccata* (a variety of prostrate growth) throve splendidly on alkali soils, which will not retain other useful growth. It attains a growth in one season of 16 feet in diameter, of thick-matted growth, yielding 20 tons of green feed to the acre. Probably two cuttings of 20 tons each can be made each season."

The following is the analysis of this plant grown in California, made by Mr. M. E. Jaffa:—

ANALYSIS OF *Atriplex semibaccata* (CALIFORNIA).

Water	78·03
Albumenoids	2·75
Nitrogen—free extract	10·41
Fat (oil)	·48
Fibre...	3·75
Ash ...	4·58

The ash contains 40 per cent. common salt. This agrees very closely with the figures obtained as an average of the samples locally collected and examined, and exhibits the same diminution in ash and salt as was observed in the sample grown under cultivation at Wagga, the indigenous plants showing a higher percentage of ash and common salt.

If it is worth while to import saltbush seed for cultivation in California it is surely worth while to encourage these plants in our drought-stricken districts, if only to the extent of preventing them from being kept eaten down by overstocking.

It should be possible, if it were seriously attempted, to assist their propagation materially, as they grow readily and prolifically from seed, from cuttings, and from the root.

In good seasons there seems to be no reason why saltbush should not be cropped like lucerne and conserved as dry fodder for times of drought.

TAGOSASTE OR TREE LUCERNE (*Cytisus proliferus*, Linn.).

SEEDS of this plant were sown in drills in April, 1895, the drills being 4 feet apart, and the seed was sown very thinly in the drills. Before sowing I placed the seeds overnight in a dish; poured boiling water over them, and let them stand in the water till required for sowing. The seeds germinated well, and the plants soon made headway. When they were about 6 to 8 inches high I thinned them out to 4 feet apart, thus bringing them 4 feet apart each way. I found this was quite close enough, as in about eight months the plants were touching, and at twelve months they were from 10 to 12 feet high. The plants left to seed were just coming into flower in August. This is about sixteen months from time of sowing. Although Tagosaste is a very strong growing plant, the foliage is thin and light, and the yield per acre is not anything like what one would expect. It is a most valuable plant in times of drought, but I would not recommend it to be grown on a large scale as a forage plant.

TAGOSASTE OR TREE LUCERNE (*Cytisus proliferus*, Linn.).

This plot of Tagosaste served to show what a mistake it is not to pay more attention to our own native fodder plants, as next to it was a plot of "Old

Man" saltbush (*Atriplex nummularia*, Linn.), sown at the same time, which yielded nearly twice as much fodder. I also noticed that the cattle preferred the saltbush, and I certainly believe that it is more nutritious.

I tried transplanting a number of Tagosaste plants, and succeeded fairly well, but I find that it is a risky plan, and would not recommend it.

BOKHARA CLOVER (*Melilotus leucantha*).

SEEDS of this plant were sown in drills, 4 feet apart, during the month of April, 1895, and the plants were afterwards thinned out to 2 feet apart. They grew strongly for a time, but were attacked by grubs, which nearly denuded them of their leaves. This killed some few of them, and checked the growth of the remainder. The remaining plants, however, soon regained their leaves and grew strongly. The yield was not very heavy, but considering the disadvantages under which the plants were grown, I think that this crop is worthy of further experiment. It stands the hot, dry weather well, and stock appear to be fond of it. I would recommend sowing rather thickly, as the plants are inclined to make strong, woody stalks. Care should be taken not to let the plants get too high, but they should be cut often, and the foliage will be thick and succulent.

SULLA (*Hedysarum coronarium*, Linn.)

A NUMBER of sowings were made in order to ascertain which is the best time to sow, and so far plants grown from seeds sown in April have done the best. The plants made a strong growth, and produced a mass of rich, succulent fodder, somewhat resembling a giant clover. Cuttings were made in September and October. The plants left for seed came into flower in November, and continued to flower for from six weeks to two months, and then produced a heavy crop of seed. When the plants were in flower the plot presented a very striking appearance, being completely covered with deep, rich, red blossoms.

During the summer months this crop did not succeed very well, being much parched by the hot, dry weather. As the season was such a trying one, the test was hardly a fair one; but still I am rather doubtful of sulla being of much value as a fodder crop in this district. I am, however, inclined to think that it would succeed well in colder and more moist districts, and would advise farmers giving it a trial. Stock are exceedingly fond of it, and it appears to be especially suitable for milch cows.

SACALINE (*Polygonum sacalinense*).

THIS is another so-called forage-plant which I am afraid will cause a lot of disappointment. Coming here, as it does, with such a wonderful reputation, one expects some great results; but the trials at Wagga Wagga seem to point to its being anything but a valuable forage plant. It is true that the past summer was a very trying one, and therefore the plants did not get a fair chance. Before condemning it entirely, I shall give it further trials, and publish the results. The method of culture adopted was as follows:—A small seed-bed was formed of very fine sandy soil; this was raked very carefully, and then pressed gently with the back of the spade. The seeds were then sown and covered lightly by sprinkling fine soil over them. The bed was well watered regularly with a watering-pot having a fine rose. The seeds germinated well, and the plants grew strongly as long as they were well watered. They were transplanted into a large bed of sandy soil, being put in rows 3 ft. x 3 ft. They made a fine growth till reaching a height of 18 inches. This was in January. The weather was very hot and dry, and the plants then began to wilt badly. They remained quite at a standstill for two months, and then died down to the ground. I notice that they are now (August) making a fresh growth, and hope for better success this coming season.

PRICKLY COMFREY (*Symphytum asperrinum*).

A NUMBER of roots of this plant were obtained from the Hawkesbury Agricultural College, and planted out in rows 2 feet apart, and 18 inches between each root in the rows. Every root grew, and the plants have done fairly well; but after eighteen months' trial I am sure that prickly comfrey is not of the slightest value as a fodder plant for the warm dry parts of the Colony, such as Wagga.

SERRADELLA (*Orinthopus sativus*, Brot.).

APPEARS to be of no value here. Grows well, and yields large crops of seed. The quantity of foliage it produces is very small, and, so far as I can tell, the bees did not appear to be particularly fond of the flowers. Its chief recommendations were as a forage and bee plant. It may, therefore, be considered as valueless for this district.

TEOSINTE (*Euchlœna luxurians*).

THIS plant is so little known and appreciated among our dairymen that it will be as well to give the late F. von Mueller's report upon it:—"Highly recommendable as a fodder-grass for regions free from frost. A large number of stems, sometimes as many as ninety, spring from the same root, attaining a height of sometimes 18 feet. The leaves grow to lengths of 3 feet, and form a good forage. The young shoots, when boiled, constitute a fair culinary esculent; the plant requires about ten months to ripen seeds from the time of sowing. In its young state is remarkably saccharine. Vilmorin estimates one plant sufficient for feeding two head of cattle during twenty-four hours. Mons. Thoyet, at Rockhampton, obtained plants 12 feet high and 12 feet wide, in damp alluvial soil, each with thirty-two main stalks, bearing nearly one hundred flower bunches. It is rather slower than maize, but lasting longer for green fodder. Its growth can be continued by cutting the tufts as green fodder; thus tender food is continued; also, it does not cause colic to horses or cattle. As a forage-plant it is without a rival in warm climes. In Fiji, sown at 4 feet apart, it forms impenetrable masses. Requires humidity to come to its greatest development. Each plant requires at least 16 square feet of ground for its full development." I have grown it at the farm successfully, in 4-feet rows; on rich dark alluvial flats it would have to be sown wide, with due consideration to its growth. Makes splendid green feed and best of ensilage.—H. V. JACKSON, Manager, Richmond River Experiment Farm.

Pulses.

G. VALDER,*
Principal, H.A. College.

Cow-pea (*Vigna catiang*, Endl.).

Of late years great interest has been taken by farmers in trying to obtain new pulses suitable for our hot dry districts, and one of the best introductions in my opinion is the cow-pea. This plant appears to be a most desirable addition to our fodder plants, and is also of great value for its manuring qualities. It has been proved that it will thrive well during our warmest and driest summers, producing large crops of succulent fodder, which farm animals of all sorts are extremely fond of. It is a most desirable plant to sow in rotation with cereals. Wheat lands that are in the state which is generally termed "worn-out" are restored to their fertility by ploughing-in a crop of this plant, and even when the crop of cow-pea has been fed off by sheep or cattle the effect is a most striking one on the succeeding crop. All the warm parts of the Colony are suited to this crop. The following are a few notes on its cultivation:—Almost any soil is suitable, provided it is well ploughed and pulverised. The time to sow is in spring, as soon as frosts are over; early in October is best for the general crop. If possible sow in drills about 3 feet apart, and drop a pea every foot in the drills. Sown in this manner 7 lb. to 10 lb. of seed will cover an acre. Broadcast, from ½ bushel to 1 bushel of seed is required. The peas ripen in December to January. When sown in drills it is advisable to stir the soil well several times before the plants commence to cover the ground.

Varieties.

1. *Black.*—As a farmer's crop, this variety decidedly stands first, producing the heaviest yield both of green food and dry pulse. From its appearance I consider that it is also the best variety for green manuring. The plants are very hardy, and the stems are thick and well covered with leaves. The pods are long, even, and well filled. The peas are quite black and larger than any other of the varieties. Average number of pods on a plant, twenty-eight; average number of peas in a pod, fourteen. In consequence of the very satisfactory results obtained, and the small quantity of seed procurable in the colonies, the Department is endeavouring to obtain a supply of seed of this variety from America.

2. *Small White.*—A quick-growing, heavy-yielding variety, with finer and longer stems and smaller leaves than the Black. One of the best for culinary purposes. The pods, cut up and served in the same manner as French beans, are very tender, and of a fine flavour. The seeds, shelled out and used in the same manner as green peas, make a delicious vegetable. It is also a good fodder for stock. Average number of pods on a plant, forty-one; average number of peas in a pod, eleven.

3. *Clay-coloured.*—A strong-growing, hardy variety, second only to the Black as a farmer's crop, but not equal to Small White as a vegetable. Plant

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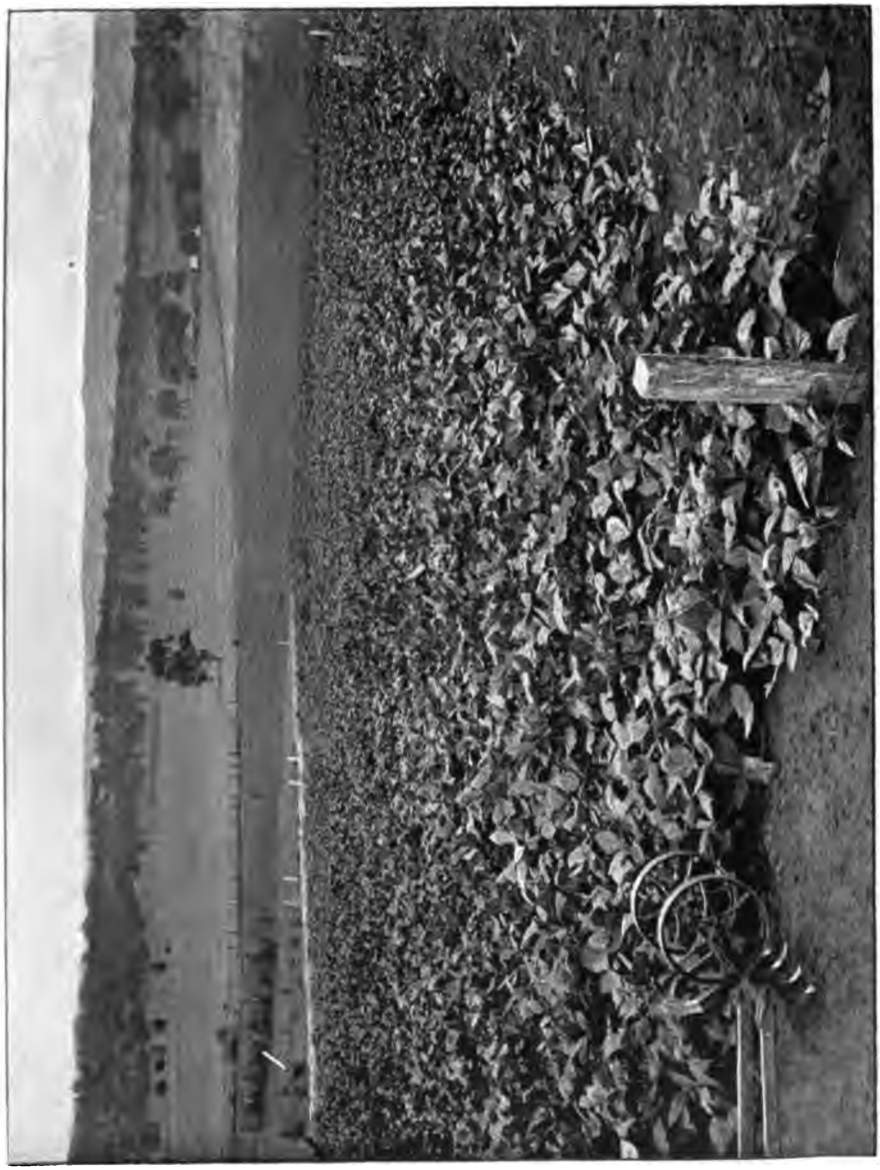
* Late Manager, Experiment Farm, Wagga Wagga.



PLOT OF COW PEA AT WAGGA, SHOWING DENSE MASS OF FOLLAGE.

quite of a climbing habit, but does very well on the ground, the yield of pulse being very satisfactory. Average number of pods on a plant, thirty-two; average number of peas in a pod, fifteen.

4. *Large White.*—The quickest-growing and most upright in habit of all. A first-class variety as a vegetable, but not equal to any of the former three in yield. A good variety for green-manuring. Average number of pods on a plant, twenty-six; average number of peas in a pod, ten.

The other varieties are far below these in value in every way. The four which I have described are well suited for cultivation here, and I should strongly recommend their trial by farmers in the warmer portions of the colony, as I am sure that they will prove a valuable addition to the crops grown in these parts. Recently the Colonial Sugar Company offered 3d. per lb. for seed grown in the Colony. In the warmer districts, during a fair season I am confident that a crop of from 30 to 40 bushels per acre and upwards could be obtained; at the price offered this would give from £22 10s. to £30 per acre. As the cost of cultivation for this crop is very small, it can easily be seen what a splendid return this would be. On our northern rivers two crops could easily be obtained off the same land in one season, the first sowing being made at the end of August, and the second at the beginning of January.

At the present time seed of any of the varieties of this crop is very scarce, but the Department has distributed a large number of samples during the past two seasons, from which it is hoped that farmers will obtain enough seed for a fair trial. As an instance of what can be done in this way I may state that from a quarter of an ounce of black cow-pea sent to the Department by one of the State Agricultural Departments in America, I obtained no less than 5 lb. of good seed. This is sufficient to cover an acre, which at the same rate should produce 30 bushels.

Nebraska (U.S.A.) Experiment Station *Bulletin* contains the following report:—"The cow-pea (*Vigna catiang*, Endl.), is to the southern farmer what red clover is to the northerner. It is cultivated extensively, and is fed green to cattle or preserved as ensilage, or used as green manure for exhausted fields. Some even say that a poor field is better after a crop of cow-peas has been taken from it than it was before, on account of the way that its roots penetrate the soil and bring up to the surface plant food which was not before available. With us only a few preliminary experiments have been made to see whether the cow-pea would do well on this soil. We have made no comparison with other plants as to its value for feeding. The varieties known as Whip-Poor-Will, Black, Blackeye, and Clay-coloured have been tried two years. All grow very rank and thrifty, 18 inches to 2 feet high, and completely covered the ground between the rows. Cow-peas grow best in hot weather, and respond very quickly to cultivation. The chemical composition is much the same as that of red clover."

LIMA-BEAN (*Phaseolus lunatus*, Linn.).

THE large Lima-bean is a climber, and is often found growing on trellises and poles in gardens in various parts of the Colony, but only to a very small extent. This bean has never received anything like the attention it should do. I consider that it is a most valuable summer vegetable, and should be grown in hundreds, or even thousands, of acres in this Colony. In California and other parts of the United States it forms one of the principal summer vegetables, being grown very extensively. It requires but little rain, great heat, and very little care. I consider that no station and farm in the warm parts of this Colony should fail to have a large patch of this bean. Not only does it produce enormous crops of green beans during the hot summer months, but the dry beans, when soaked for about twelve hours and then boiled in the same manner as haricots, form a most desirable addition to our winter vegetables.

Seeds of this bean can be obtained from almost any seedsman. On no account should sowing commence until warm weather sets in. Many people have failed with this crop through sowing too early. The plant requires heat, and will not stand the cold nights so often experienced here during August and September.

In order to try and make this vegetable popular, I sent a dish or two of the green beans to a number of people in different parts of the Colony, and in every case they reported that they were superior to any shelled bean they had ever tried.

Sow the beans in drills about 4 feet apart, dropping a seed every foot in the drills. Cultivate well between the drills until the plants commence to cover the ground. After this they will take care of themselves.

There are several dwarf varieties which are cultivated in a similar manner to French beans. Of these the large-seeded varieties lately introduced are by far the best.

SOY-BEAN (*Soja hispida*, Mœnch.).

SEEDS of three varieties were obtained, viz., "Common White," obtained from a local seedsman; "Improved White," from the United States; and a black variety from Queensland. These were sown in drills 2 feet apart, and the plants were thinned out to 1 foot apart in the drill. At first the plants grew rather slowly, but as the weather became warmer the growth was more rapid. When about 15 inches high the plants of "Common White" and "Black" were badly attacked by bean-rust; but, strange to say, the plants of "Improved White," which were growing next to these varieties, were not affected in the slightest degree. The "Improved White" variety appeared to be well suited for this climate, as the plants grew very rapidly; in fact, I was inclined to think that they were making too much leaf, and that the yield of pulse would, therefore, suffer, but from the results obtained it will be seen that this could not have been the case. So badly affected were the other two varieties that I was afraid they would not seed; but heavy rains, soon after they commenced flowering, somewhat revived the plants and a fair return of pulse was obtained, but the yield must have been much impaired by the disease. When fully grown the plants of the "Improved White" variety were from 3 feet to 3 feet 6 inches in height, and nearly 2 feet through 9 inches from the top of the plant. The stalks are strong and woody, and they have numerous branches covered with heavy foliage. The stalks and branches are thickly studded with clusters of hairy pods. In order that a fair idea of the productiveness of these plants might be obtained, I counted the number of pods and number of beans on each of the first six plants in the drill with the following result:—

No. 1 plant	... ...	182	pods, containing	443	seeds.
" 2 "	... ...	237	"	679	"
" 3 "	... ...	209	"	586	"
" 4 "	... ...	284	"	781	"
" 5 "	... ...	241	"	663	"
" 6 "	... ...	262	"	735	"

PLOT OF SOY BEAN AT WAGGA.

This would give an average of 235 pods on each plant, containing 648 seeds. Average number of beans in a pod, 2·7. Most of the pods had three beans in them. One branch on plant 4 had no less than 114 pods on it. A portion of the plants were fed to cattle just as they came into flower, and I found that they were preferred before any other pulse which I had growing. The remainder were pulled as soon as the pods were ripe, and were laid out in the sun to dry; the pulse was then threshed out and the dry haulms were fed to cattle, who appeared to be very fond of them. The results obtained will be found in the following table:—

No.	Name of variety.	Seed obtained from—	No. of days in which the crop occupied the land.	Yield of dry pulse per acre, in bush. of 60 lb.
1	Improved White ...	United States ...	148	47
2	Common White ...	Sydney	135	13*
3	Black	Queensland	127	9*

* Badly affected with bean-rust.

The only fault that I could find with the Soy-bean was that it was too slow in ripening its seed, it being nearly five months in coming to maturity; but I noticed that the plants grew best during the month of January, especially during one hot dry week; and I, therefore, believe that this plant is best suited to the warmer parts of the Colony. I should strongly recommend farmers to plant a small area with this crop, as the beans, shelled out when quite green, form a delicious vegetable, and the plants after the pods are taken off make very good feed for cattle.

The department obtained a small quantity of seed of the common white variety and distributed it to a number of farmers in different parts of the Colony. The seed germinated badly, but most of the plants that were obtained grew remarkably well.

Mr. J. Allison, Eglinton, Bathurst, reports as follows:—The seeds received were very deficient in vitality, only three plants coming to perfection. These proved very vigorous and prolific, reaching a height of from 2 to 2½ feet, and bearing a quantity of delicious beans. I think this will prove a real acquisition to the list of choice vegetables.

Mr. J. Taylor, Reedy Creek, Rylstone, says:—"The Soy-bean grows well in this district, attaining a height of 3 feet 6 inches, and being covered with pods; in fact, so heavy a crop did the plants bear that I was obliged to put in stakes and tie them up, in order to prevent the plants being broken down. The beans are delicious eating."

Mr. Charles Mapperson, junr., of Tattaila, Moama, states that he believes the Soy-bean will stand the hot summer weather better than any other bean which he has yet tried, but it must be sown in the early spring.

THE KIDNEY OR FRENCH BEAN (*Phaseolus vulgaris*, Linn.).

TWENTY varieties were sown, ten of the green-podded and ten of the yellow-podded (butter or wax beans). The seeds were sown in drills 2 feet apart by 4 to 5 inches apart in the drill. One drill 33 feet in length was sown of each variety. The soil was not broken up as fine as it should have been for this crop, and the plants were not watered; but the plot was kept free from weeds, and the weather was very suitable, being warm and very showery for the first six weeks after sowing. The crop therefore grew strongly, and the experiment proved in every way a success, every variety maturing its seed. All the yellow-podded varieties were attacked more or less by "bean rust," the result being that the yield of these did not compare favourably with that of the green-podded varieties, which were almost entirely free from this disease. From my experience I have found that the yellow-podded varieties are always much more liable to "bean rust" than the green-podded ones, the latter rarely being affected. About three months after sowing, the weather being warm and dry, the beans ripened rapidly. The pods were gathered as fast as they ripened, and were placed in thin calico bags and hung up in a shed to dry. (For notes on "Rust" see page 228.)

The following table will show the comparative results obtained :—

No.	Name of Variety.	Obtained from—	Germinated in No. of days.	Came into bloom in No. of days.	1st edible pod, No. of days.	1st ripe, No. of days.	Yield of dry beans per drill of 33 ft.	
							lb.	oz.
1	Emperor William	Hockings, Brisbane	6	38	53	81	2	9
2	Prof. Blount's Blue	W. Farrer, Tharwa, Queanbeyan ..	7	43	53	72	3	8
3	Canadian Wonder	....	8	39	50	78	5	2
4	Pale Dun	....	7	35	46	74	4	11
5	Negro	....	8	38	51	79	4	9½
6	Governor Denison	....	8	36	50	78	3	5
7	Dwarf Zion House	Hockings, Brisbane	6	36	48	73	3	9
8	Carter's White Advancer ..	E. & W. Hackett, Adelaide	7	40	50	81	4	2
9	Dwarf White Caseknife ..	,, ,, ,, ...	6	36	49	74	2	7
10	Haricot	D. Manson, Albion Park	6	42	51	77	3	4
11	German Black Wax	Yates, Sydney	6	39	49	81	1	15
12	,, ,, ...	Shepherd & Co., Sydney	8	38	59	77	1	14
13	New Caledonia Black Wax ..	Parker & Co , Sydney	7	44	60	86	2	9
14	Golden Butter	Horton, Sydney	7	43	52	78	2	3
15	Yosemite Mammoth	P. L. C. Shepherd and Son, Sydney..	7	40	58	73	2	14
16	White Wax Bean	Yates, Sydney	8	40	49	76	1	8
17	Green Gem	Adamson & Co., Melbourne	6	38	50	74	2	11
18	Golden Wax	Yates, Sydney	7	40	52	75	2	1
19	Dwarf Mont D'Or	Anderson & Co., Sydney	7	41	53	72	2	11
20	Golden Mountain	W. Farrer, Tharwa, Queanbeyan ..	7	39	51	76	2	6

Of the green-podded varieties, the following gave by far the best results :— Canadian Wonder, Carter's White Advancer, Negro, and Pale Dun.

Of the yellow-podded varieties I consider the following are most worthy of cultivation here :—Yosemite Mammoth, Dwarf Mont D'Or, and Golden Wax.

Green Gem and New Caledonia Black Wax, two light green-podded varieties, are also very productive and of a fine flavour.

Short descriptions of all the varieties under trial are given herewith.

1. *Emperor William.*—Plants 12 to 15 in. high; strong and upright in habit; flowers, cream to white; pods 4 to 6 in. long; nearly straight and very fleshy; seeds white, oval, and plump; a good table variety of fine flavour, but rather a shy bearer.

2. *Prof. Blount's Blue.*—Plants upright and strong, but very irregular; 12 to 18 in. high; flowers violet; pods 5 to 6 in. long, well filled; seeds small, dark crimson, nearly black; a very good variety.

3. *Canadian Wonder.*—Plants large and strong; 18 to 20 in. high; much branched; leaves large and coarse; flowers pink; pods very large and numerous; rather rough; beans large; nearly twice as long as broad; dark crimson, nearly black; the hardiest, strongest grower and heaviest yielder of all.

4. *Pale Dun.*—Plants very large; much like No. 3, but leaves are darker and the flowers are white; pods, 5 to 6 in. long, straight and tender; beans light dun; one of the best.

5. *Negro.*—Plants 15 to 18 in. high; much branched; leaves rather large and coarse; medium green; flowers violet; pods 5 to 7 in. long; beans quite black; a heavy yielder and one of the best for culinary purposes.

6. *Governor Denison.*—Plants much resemble No. 5, but flowers are white; pods long, straight and succulent; beans white splashed with crimson. This variety appears to be very suitable for warm districts, as on the hottest day the leaves do not droop, and with a fair amount of moisture it always yields well.

7. *Dwarf Zion House.*—Plants 15 to 18 in. high, upright; branches slender with small leaves; pods 4 to 6 in. long, slightly curved; seeds much like No. 6, but splashed with a darker crimson and not so large; a very fair variety; stands heat well.

8. *Carter's White Advancer.*—Very strong growing plants, with light green foliage; flowers white; pods very large, 6 to 8 in. long; beans white, large; an excellent variety, superior to Canadian Wonder for tenderness and flavour, but not nearly equal to it in yield.

9. *Dwarf White Caseknife.*—Plants 15 to 18 in. high; stems slender and inclined to short runners; leaves dark green, rather large; flowers white; pods were long, but did not fill out very well; beans white, sides slightly flattened.

10. *Haricot.*—Very similar to above, but stronger in growth; pods long and well filled; beans pure white, very plump.

11. *German Black Wax.*—Plants 12 to 15 in. high; strong growing and much branched; leaves large, medium green; flowers violet; pods 4 to 5 in. long, not very numerous, but well filled: yellow and nearly stringless; medium rusty.

12. *German Black Wax.*—Similar in habit to No. 11, but not so strong in growth, and both pods and beans smaller; very rusty.

13. *New Caledonian Black Wax.*—This is really a dwarf climber; stems slender and leaves small; plants much branched; pods small, but very numerous; light green; very fine flavour; beans small; quite black; almost free from rust.

14. *Golden Butter.*—Plants tall and very robust; leaves large and rather coarse, medium green; flowers violet; pods about 4 in. long, thick and succulent; beans black, large and nearly round; medium rusty.

15. *Yosemite Mammoth.*—Plants 15 to 18 in. high, strong, much branched; leaves large, medium green; pods long, slightly curved, stringless, very succulent and of a beautiful golden yellow colour; a very fine table variety, nearly free from rust.

16. *White Wax.*—Plants 12 to 15 in. high, not very strong; leaves small, pale green; flowers white; pods very numerous, rather small, nearly straight, light yellow; beans dull white; very rusty.

17. *Green Gem.*—Plants fairly strong, 15 to 18 in. high; leaves small, pale green; flowers white; pods light green, rather small, narrow and straight; beans long, narrow, and rather small, of a peculiar light green colour when dry; a very distinct variety, productive, and of excellent flavour, nearly free from rust.

18. *Golden Wax.*—Plants 12 to 15 in. high, not strong; leaves small, rough, pale green; flowers dull white; pods numerous, 4 in. long, rather wide and curved; beans rather small, white speckled with red; very rusty,

19. *Dwarf Mont D'Or.*—Plants tall and slender; leaves small, rather a deep green; flowers violet; pods 4 to 5 in. long, narrow, curved, very plump, bright yellow; beans nearly round, shining, deep purple, nearly black; a very productive and good table variety, but slightly rusty.

20. *Golden Mountain.*—Resembles No. 19, but the pods are much flatter, and nearly white; although very rusty, gave a very fair yield.

Three new varieties were under trial, the seed of which was received from Chicago Exposition, and arrived too late to be included in above trials, viz., "Celery," "Early Refugee," and "White Navy." Of these the "Celery" and "Early Refugee" varieties were found very suitable for using in the green state, producing a heavy crop of fairly large and nearly stringless beans, although as an all-round bean, I doubt if either of them are equal to "Canadian Wonder." The "White Navy" is a suitable variety for using in the dry state as a haricot, yielding a heavy crop of small but plump beans, which were found to cook well, and were of very fine flavour.

HORSE GRAM (*Dolichos biflorus*, Linn.)

THREE samples were sown, two of the yellow variety and one of the black. One yellow and the black sample were obtained from India, and the other yellow one from Queensland. About 80 per cent. of the seeds germinated. The plants grew very slowly at first, but grew faster during the hot weather, and attained a height of about 3 feet. At this time the plants, which are of a climbing habit, had become a complete mass, and it was impossible to separate the varieties. However, as the growth of the three samples sown was about the same in every way, I decided to cut a portion and estimate the yield of greenstuff per acre. This was done on the 25th February. The result was 4 tons 13 cwt. per acre. As the crop was nearly five months occupying the land before it was ready to cut, I consider that it is a very poor return in comparison with that of the cow-pea, which was growing close to it, and was treated in the same manner. Horses and cattle eat it readily, but much prefer the soy-bean and cow-pea. The remaining plants made little or no further growth, and at the end of March they gradually died off. They did not show any signs of flowering, although occupying the ground for nearly six months. This crop might, perhaps, be valuable in the warm dry parts of the Colony as a forage, but I do not think it would ever be of any value for its pulse.

A small sowing of seed of this plant was made on the 12th October, 1894, with the object of testing its suitability as a forage-plant for the Wagga district. The result was satisfactory to a certain extent, as a fine crop of forage, which the cattle seemed to do well on, was produced in the warmest part of the summer, but the yield was much behind that of cow-pea and several other pulses sown at the same time. It certainly thrives remarkably during the hot dry weather, and might perhaps be valuable in times of drought, or in districts with a lower rainfall than Wagga Wagga; but I do not think that it will ever be a popular forage-plant in this district.

MUNG-BEAN (*Phaseolus mungo*, Rox.)

FOUR varieties were sown on the 8th October, 1892. The seed of each variety was very good, the plants coming up very evenly. The seed was sown in drills 18 inches apart, and the plants were thinned out to 6 inches apart. This crop is evidently well suited for cultivation here, the plants growing strongly and requiring very little attention. All the varieties were in full flower the first week in December, and the crops were ready for harvesting about one month later. The plants were pulled up and laid in the open to dry for two or three days, and the pulse was then threshed out, the following returns being obtained:—

No.	Name of Variety.	Seed obtained from—	Number of days in which the crop occupied the land.	Yield of dry pulse per acre. Bushel of 60 lb.
1	Light brown... ...	Queensland	93	13
2	Dark green	,, ...	102	26½
3	,, ...	India...	107	22
4	Light green	New South Wales ...	88	25

As will be seen on reference to above table the light green variety proved to be much superior to the other varieties in yield, and also quicker in maturing. The pulse also is larger and more even in size. A few weeks before harvesting this plot presented a very curious sight, the plants being thickly covered with the black pods. The average height of the plants was about 18 inches when full grown. I shelled out a dish of the beans when the pods were fully formed, and had them cooked and served up in the same manner as green peas, and found that they were very palatable. I do not, however, think that they will ever be used largely for this purpose, as it takes too long to shell them out, the pulse being so small. From my experience with this crop, I am confident that it can be grown successfully in all but the very cold parts of the Colony, but I do not think it is likely to be grown extensively, as there are so many more suitable pulses already under cultivation. In India the pulse is ground into flour and is then made into cakes, but I am afraid that it would take a long time to educate the taste of the people of this Colony in this direction so that the pulse would be in large demand. The average number of pods on a plant was 117, and the average number of beans in a pod, eleven. The Queensland samples were presented to the department by Mr. Bailey, the Colonial Botanist; the Indian sample was taken from a quantity imported by the department; and the New South Wales sample was presented by Mr. C. E. Wilson, of Carcoar, who had grown it under the name of "Curry-bean." Since the above comparative trial the mung-bean has been grown each year at the experiment farms, and thrives well in all the districts in which it has been tried.

SQUARE-PODDED PEA (*Lotus tetragonolobus*).

Seeds of this plant were received from California and from Baron von Mueller. The plant has been strongly recommended for green-manuring, being richer in nitrogen than even cow-pea, but the experiments carried out here tend to prove that it is nothing like as suitable for that purpose in this district. Cow-pea will produce from five to six times as much foliage as that of lotus in the same time; it stands the heat much better, and yields a much heavier crop of seed. It is true that the lotus stands the cold weather well, but the growth is so small that it will not compare with other leguminous crops sown at the same time. Several sowings were made at Wagga Wagga, and all grew well, the best yield being obtained from that sown in May.

DOLICHOS, Sp.

Two varieties, one a dwarf and the other a climber, were received from Japan. The plants of both grew well, and produced enormous pods, but did not mature their seed, being cut down by early frosts. Although these beans are said to be edible it was found that they were a very coarse vegetable, and appeared to be more suitable for cattle feed. These giant beans attracted much attention at the Agricultural Shows at which they were exhibited.

A number of other species and varieties of beans from Japan were under trial, but none of them so far have proved to be of much value in comparison with the varieties grown here.

Another variety of dolichos, received under the name of "Madagascar" Bean, proved to be a very valuable table bean for this district, producing enormous crops of tender cut beans of delicious flavour right through the summer. As this plant is a really handsome climber, as well as a vegetable, it is bound to become very popular.

CHICK-PEA OR GRAM (*Cicer arietinum*).

Two samples of the red-seeded variety and one of the white were sown. The white variety was imported from Europe, and one sample of the red from India; the other red sample was grown by Mr. Niblock, of Cooma, from seed supplied him by the department. The seed was sown in drills 18 inches apart by 4 inches apart in the drills. The cultivation given them was similar to that usually adopted for dwarf field peas. The seed germinated in from five to six days, and the plants grew rapidly, the whole plot being well in flower in about six weeks from the time of sowing. The red variety has pink flowers, and the white-seeded one pure white. The fern-like foliage of these plants gave the plot a very distinct and pretty appearance. As soon as the pods were fairly ripe the plants were pulled up and laid in the sun to dry. The pulse was then threshed out, and the following results obtained:—

No.	Name of Variety.	Seed obtained from—	No. of days in which the crop occupied the ground.	Yield per acre. Bush. of 60 lb.
1	Red-seeded	India	93	27½
2	,, ...	Cooma, N.S.W. ...	88	32
3	White-seeded ...	England	97	21

Red-seeded variety is the hardiest, quickest in maturing, and best yielder of the two varieties. It is of little or no value as a vegetable, although it makes very good pea-meal for soups. It is considered a good pulse for horse-feed, and is also a capital change feed for poultry. As a green food it is of no value, and I do not consider that it would be of much value as a green manure, the yield of greenstuff being very small in comparison with other pulses. I should recommend its cultivation in all but the very cold parts of the Colony as it is a quick grower, will yield two crops in the one season on the same land, maturing in about ninety days, stands heat and drought well, and bears a heavy crop.

White-seeded variety.—This variety is the one which is largely grown in the south of Europe, where it is used in soups and as a vegetable. The plant is taller and more robust than the red-seeded variety, being about 18 inches high by about 10 inches through, whereas the red-seeded variety was only from 12 to 15 inches high by about 6 inches through. I shelled out several dishes of the peas and had them cooked in the same manner as garden peas, and also tried them in soups. The flavour is much the same as that of the common pea, but it requires more boiling. I consider that it is worthy of cultivation on a small scale during the hot summer months when the common pea is scarce, but at any other time it is not equal to the common pea, as it does not yield as well, and the peas are more trouble to shell out, there being only two peas in a pod.

One drawback to the cultivation of the chick-pea is that it is very liable to the attacks of a small caterpillar, which bores into the pods and eats the peas, but, of course, this trouble can easily be got rid of by the application of Paris green.

Another plot was sown on the 12th October, 1894, with the white, red, large red, and Tippo Tib (black-seeded) varieties. The seed of the latter two was presented to the department by Baron von Mueller, Botanist to the Victorian Government. They were both large-seeded varieties, and proved to be very suitable for this district, the yield being even and heavy. The four varieties ripened their seeds at nearly the same time, viz., from 4th to 18th January. The first picking of dry peas was made on the eighty-fourth day from the time of sowing. A portion of the seed of this crop was sown on the 21st January, 1895, in order to see if two crops could be obtained in the one season. The result was very satisfactory, as a heavy crop was obtained from this sowing at the end of April. As a test as to the hardiness of this plant, I decided to make another sowing, and a plot was therefore sown on the 19th April. The seed germinated in four days from the time of sowing, and the weather being favourable, the plants make rapid growth, producing a heavy crop of foliage at least double the weight of that produced by the summer crops, but they did not mature any seed. The plants flowered freely and formed their pods, but they did not fill. Eventually they were cut down by a severe frost at the end of July. This yield of foliage was made at a time when green feed is scarce, *i.e.*, midwinter, and numbers of farmers who saw the crop were of opinion that it would prove valuable as a forage-plant. It is intended to carry out further experiments in order to see if it would pay to cultivate this plant for forage. The trials already made plainly show that the chick-pea is a valuable plant for this district for its pulse alone, two heavy crops of peas being obtained in the one season. As the plots under trial were small, and different sized plots of each variety were grown, it is rather difficult to give the comparative yields, but this season large plots of the same size have been sown, and particulars of the yield obtained will be published later on.

This pea is largely used in the dry state for horse-feed in hot countries, principally India, and I certainly think it should be grown in the hot dry portions of this Colony, especially in districts too dry for maize. The plant requires but little moisture, and with very little cultivation produces a heavy crop. The samples grown at Wagga Wagga were very fine, the peas being even, full, and a good bright colour.

PIGEON-PEA (*Cajanus indicus*, Spreng.)

Two samples were tried—the red and the variegated varieties. The seed was sown in drills 4 feet apart, and the young plants were thinned out to 4 feet apart in the drill. At first they grew very slowly, but after a few weeks of hot weather they made rapid strides, and soon the plants in the two drills were touching. At this time they were fully 7 feet high, and were densely covered with foliage. They commenced to flower in February, and in about a fortnight later they made quite a pretty show, being thickly covered with bright yellow flowers. Towards the end of March I picked a quantity of green pods off them, and shelled out the peas and cooked them. They are of a very nice flavour, but are rather troublesome to shell out, both pods and peas being small. In April the plants were fairly well covered with pods, but they did not ripen well, the weather evidently being too cold. As a consequence, I could not get a fair estimate of the yield of dry pulse. The climate of Sydney is a little too cold for this plant, although I think that as it is a perennial it would ripen its seed earlier in the season the second year. On our northern rivers, and in several other of the warmer portions of the Colony, this plant should succeed very well. As a forage plant it should also prove of some value, especially in rotation with other fodder crops, such as maize, sorghum, &c. Six months after sowing the yield of green fodder was at the rate of nearly 12 tons per acre. I cut a quantity and gave it to horses and cattle, and found that they ate it with great relish.

VILLOUS VETCH (*Vicia villosa*, Linn.)

THIS proved to be a dwarf-growing vetch with short runners. The plants grew very quickly, commenced flowering in from six to seven weeks after sowing, and ripened their seed in from twelve to fourteen weeks. As a forage plant it is not equal to the common vetch, the yield of green plant being 4½ tons per acre, and the yield of dry pulse 23 bushels per acre. It has often been recommended as a good food-plant for bees, and from what I could observe it certainly bears out its character in this respect, as the plants, which were in flower from six to seven weeks, were continuously visited by bees in large numbers. When in flower the plants are very beautiful, being profusely covered with long racemes of pretty pink and white or purple and white flowers. I should not advise its cultivation on a large scale, but think it is worthy of a trial in small patches by beekeepers as a bee and forage plant.

ALGERIAN VETCH (*Vicia calcarata*).

THIS vetch is one that will evidently stand great heat, but it does not yield well, and I cannot recommend it as a forage plant, there being so many species superior to it in every way.

LUPINS.

Two packets of lupins, which had been received by the department from Germany, were sown with the other pulses. These two varieties were said to be the best for green-manurings. One was a yellow-flowering variety and the other a blue. As a rule, I believe that the small-seeded varieties have been found the best. These were both rather large-seeded varieties, and as far as I could tell are not equal to the smaller-seeded ones which are obtainable here, the quantity of foliage produced being very small. I made a sowing in the spring in order that I might be able to more quickly increase the quantity of seed by making two sowings in the year. This crop was harvested in about three months after sowing, the quantity of seed obtained being about 1¼ lb. of each variety. I thus had 2½ lb. seed ready for sowing in the autumn which is by far the best season. This plot should produce about 100 lb. seed, which is sufficient to sow an acre. Complaints have been received by the department from farmers that it is very difficult to obtain sufficient lupin seed from the local seedsmen for sowing large areas. This experiment will serve to show how easy it is to obtain a large supply at a small cost and within a short period of time.

This completes the record of the fifty-four species and varieties of pulses sown in connection with this experiment. As will be seen, these seeds were obtained from all parts of the world, and they were in many cases three or four years old. Yet when sown with care not a single species or variety failed to germinate. Nearly all of them came to maturity and gave very fair results, thus proving how well the climate of this Colony is adapted for pulse-growing.

WAGNER'S FLAT PEA (*Lathyrus sylvestris*, Linn.)

THIS sample was taken from a quantity which was imported by the department from England in August, 1890. The seed was distributed the following month to some 300 farmers in all parts of the Colony, and of these experimenters no less than 30 per cent. stated that the seed did not germinate. And yet a portion of the same seed which was sown by me with the other pulses two years later (8th October, 1892) came up very evenly, fully 60 per cent. of the seeds germinating. The plants, although looking perfectly healthy, grew very slowly, and at the end of nine months were not more than from 6 to 10 inches high. Of the fifty-four different pulses sown in these plots, this one was by far the slowest grower, and at the end of nine months only produced about half a ton of green plant per acre. Being a very deep-rooting plant, and a perennial, it was thought by some of the experimenters in this Colony that it might produce a large yield the second or third year, and that it would stand the dry weather well, but from reports received by the department it has certainly failed either in giving a good yield or withstanding the heat, and in many instances has died right out.

In consequence of the large amount of attention given by the press to this plant during the past few years, it was decided to give it a further trial. Sowings were made both in spring and autumn, and weeds were carefully kept down, but all to know purpose. The plant was a failure. Instead of the large crops of forage expected from it, only a poor, weak straggling plant appeared, which suffered badly from heat and drought in summer, and was cut down by frosts in winter. Although this crop has been carefully tended to for the last eighteen months it has not yet produced half a ton of forage to the acre, while close beside it a crop of Early Amber cane sorghum produced 25 tons of forage per acre in six months.

DISEASES OF THE BEAN-PLANT.

BY N. A. COBB.

I. Bean Anthracnose (*Colletotrichum Lindemuthianum.*)

THE anthracnose of the bean plant is the disease often called bean-rust. This is a mistake, however, as the real bean-rust is quite different, and much less troublesome. The two diseases are mistaken for each other because each is characterised by the presence of brownish or rust-coloured spots. There is really little difficulty in telling the two diseases apart, if we remember that the anthracnose produces large sunken spots on the pods, while the true rust, if it attacks the pods at all (which is not often), produces elevated rather than sunken spots.

Bean anthracnose occurs, it is safe to say, wherever beans are grown extensively. I have observed it to be abundant in various parts of North America, Europe, and Australia, and have received specimens from other parts of the world. It is so excessively common that I believe it would be a matter of difficulty to secure a shipment of seed-beans not containing it; and from this fact it will be easily inferred that each new settlement has in turn, from time immemorial, received along with its bean-seed, this disease. Should the bean be in future introduced into new settlements, as, for instance, into Western Australia or Central Africa, it is possible that, by using care in selecting seed, the disease might for some time be excluded.

The disease is not confined to any particular variety of beans; it attacks all the numerous varieties, pole as well as bush, which belong to the species *Phaseolus vulgaris*. L. It is more fatal, however, to the early sorts and to those used for cooking, pods and all, before they are ripe. The various so-called wax-beans and butter-beans are particularly subject to injury, the very quality which makes these sorts most valuable, namely, tenderness, being also that which renders them most subject to the disease.

No part of the plant is free from attack: root, stalk, leaf, and pod are alike subject to attack; but the pod is the locality where the disease is most conspicuous, and likewise the place where the greatest damage is done. The damage may be regarded as of two sorts—

1. Damage caused by preventing the growth of the pod.
2. Damage caused by injury to the seed.

1. The damage caused by preventing the growth of the pod is easily seen, and easily understood. If the pods do not grow, there is no crop. If they are misshapen and small, the crop is a partial failure. Both these causes are of frequent occurrence.

The damage caused by injury to the seed is not so easy to see, nor so easy to understand; yet it is precisely on this point that I wish to lay greatest stress, as upon it is based the most important measure to be taken in combatting the disease. A thorough understanding of the whole matter makes it necessary to notice the cause of the disease, which is the fungus whose scientific name is given at the head of this section, and figures of which are here inserted. This fungus grows inside the tissues of the bean pod, and its effects are seen in the death of the tissue of the pod, and its collapse, which gives rise to the brown sunken spots which are so conspicuous. The fungus extends so deep into the tissues that it attacks the seeds inside the pod. If this occurs on comparatively well-grown pods, the size and appearance of the diseased seeds is not greatly different from healthy seed. Yet mark the difference if these diseased seeds be sown. The new seedling comes up diseased, and very often dies before it can produce its first three leaves. As everyone knows, the two halves or cotyledons of the seed "come up" with young plant. When these cotyledons are diseased—that is to say, contain the fungus as just described — they soon communicate the trouble to the tender young plant that has sprung up from them. The fungus runs riot in the succulent and tender tissues of the plantlet, which, in consequence, soon dies, or if not, at least suffers severely. Any bean-grower can demonstrate these facts to his own satisfaction, simply by sowing beans taken from badly-spotted pods, and watching the results. As soon as the young plants have produced two leaves, or even sooner, the trouble begins. The disease creeps from the cotyledons (the two half beans that come up with the plant) to the stalk and to the stems of the first leaves. Sometimes the leaves drop down, so weak do their stems become. Occasionally the stalk itself is, in a like manner, so weakened that the plant topples over as if eaten off by a cut-worm; in fact, I have known this disease acting in this way to completely deceive the grower, and cause him to attribute the whole trouble to cut-worms. The number of seedlings killed in this manner is various, but seldom exceeds 50 per cent. It is very often from 10 to 30 per cent., thus giving rise to a very poor stand, and

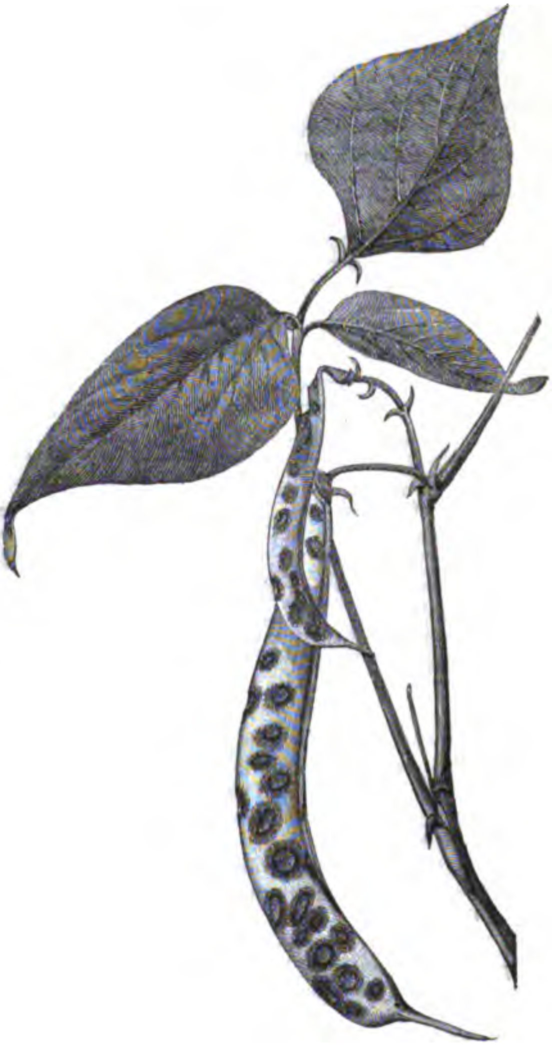


Fig. 1.—Bean pods attacked by bean anthracnose. The disease has covered the pods with sunken dark brown spots. One of the pods has failed to grow to full size, and will produce worthless seeds or none. The way in which the disease affects the beans inside the pods is shown in Fig. 2.

necessitating a great amount of tedious and expensive replanting, a loss which has to be subtracted from the margin of profit.

It will be very profitable to study a little further into the nature of this disease, for there are one or two further precautions that can be taken with advantage, and the reason for them will be made plain if the leading facts in the progress of the disease are once clearly understood. If one of the older sunken spots on the pod be examined attentively, all the better if with a magnifying glass, a number of whitish or salmon-coloured points will be seen in the midst of the dark-coloured area at the centre. These light-coloured points occur when the fungus, having come to a head (termed a stroma), has begun to produce spores. These spores are very minute, and the tiny points on the sunken spot, small as they are, contain thousands of spores cemented together by a substance which is soluble in rain-water or dew. Each spore corresponds to a seed, and is capable under favourable conditions of making another diseased spot like that from which it came. When we consider that these spores are so small that we might easily pick up a hundred thousand of them on the point of a hair—so small that hundreds of them would easily cling to a fly's foot without troubling him—so small that the slightest gust of wind might lift them several feet from the ground, and so light that they will of themselves almost float in the air, then we can easily understand how it is that many acres of beans afflicted with this disease are such a common sight.

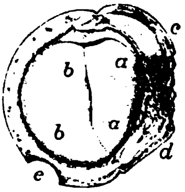


Fig 2.--A slice cut from a bean pod, and so taken as to cut through a bean and also through diseased spots caused by anthracnose. The bean is of the sort known as the black bean, so that the outline of the seed shows as a wide black line; *a a* is one half of the seed, and *b b* is the other half. That part of the figure outside the wide black line represents the pod. Two diseased spots are shown, one at *e* and the other extending from *c* to *d*. The disease has extended from *c d* through the pod and *into the seed itself* as far as *a a*. This occurred while the bean was growing, and hindered the growth of the seed, which, in consequence, appears in the figure as somewhat one-sided. The spot *e* became diseased later on, and has not yet affected the seed.

The spores germinate only in the presence of moisture. On a rainy day or a dewy eve they are dissolved from their birthplace, and floated or spattered to new places on the same plant or on other plants. There they sprout, enter, and grow, until another diseased spot has been produced, and then spores are again formed, and the whole process repeated. In favourable weather this process occupies about a week—sometimes less. There is a saying among gardeners that beans should not be cultivated or disturbed while the dew is on them or while wet, because it spreads the "rust"—by rust meaning anthracnose, the disease we are discussing. This saying, founded in experience, is in exact accordance with the facts as discovered by men of science, and is a good illustration of the way in which practical men, learning by hard experience, have often anticipated the precautions recommended later as the result of scientific research.

As said before, the anthracnose is not confined to the pod. When it occurs on the stalk it gives rise to sunken spots like those on the pod, but less defined; the spots are more inclined to run together, especially on young plants. On the leaves the fungus affects particularly the veins, turning them first brown and later on black; at the same time it affects the other parts of the leaf and similarly discolours them, and ultimately it "burns" through the leaf, making a crack with ragged edges.

Remedies.

1. *Selected Seed.*—The best remedy for anthracnose of the bean is care in the selection of the seed. The trouble taken to secure only healthy seed will be amply repaid at harvest time. The time thus spent is very profitably employed. "As ye sow so shall ye reap." He who puts in seed already attacked by anthracnose will reap a crop attacked by anthracnose—if, indeed, he reaps one at all. Healthy seed is to be procured from a healthy crop. If such does not grow on the farmer's land he can sometimes procure it from elsewhere. If not, then a selection can be made from a diseased crop as follows: First, examine the crop and harvest from the part of the field least diseased, about twice as much as is needed for seed. This selection from the crop as it stands in the field will often save much work afterwards. Second, after threshing out the beans, reject all that are in any way discoloured or shrivelled. The discoloured and shrivelled spots contain the disease, and the inspection must be such as to exclude if possible every bean that is spotted. I have in some cases hand-picked the seed in the field, gathering only the *healthiest looking pods*, and I can recommend this method when the whole crop is badly diseased. If, when badly diseased, the crop be harvested and threshed as usual, many very bad pods will be threshed out, and the sorting of the beans is about four times longer than the sorting of the corresponding pods.

2. *Spraying with Bordeaux Mixture.*—Whether this be profitable or not depends on a variety of circumstances. If the grower already has a spraying machine which is in use on other crops, it will undoubtedly pay him to spray his beans with Bordeaux Mixture if they are attacked by anthracnose. If he must buy a machine and spray for this disease alone, spraying will not pay him unless he is growing several acres of beans and habitually loses at least 10 per cent. of his crop under ordinary circumstances. If beans growing by the acre are badly attacked, spraying will pay—that is to say, the additional crop will be more than sufficient to repay the cost of spraying. The spraying should be begun early. It is of little use to wait until the disease is bad and then commence to spray. As soon as the plants have the first two leaves well grown, they may be sprayed for the first time. They should afterwards be sprayed twice or more according to the weather. If the weather be rainy more spraying is required than if dry. If a rain comes on immediately after spraying, the Bordeaux Mixture is washed off and very little good will be done unless another spraying be done again at once. The object of the spraying is to cover the plants with a substance poisonous to the spores of the disease. This kills many spores that are still attached to the spot where they grew, and furthermore prevents any spores which are not so killed from germinating on the surface of the bean plants. At the first attempt to sprout the spore absorbs some of the poison that has been sprayed, and is killed. No fear of poisoning from the eating of sprayed pods need be entertained if the last spraying was done three or four weeks before cooking. All careful cooks wash the pods before snapping them. The Bordeaux Mixture is made as usual. Prof. Fairchild recommends the addition of enough soap to form a suds. This causes the spray to cover the plants better.

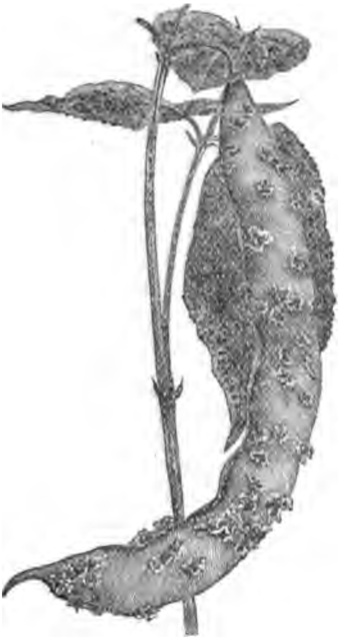
3. *Burning.*—The burning of all diseased vines and other trash is strongly advised. This should be done as soon as the same are of no further use. They should not be allowed to lie on the field, or anywhere where they can infect either the land or the crop. Very few farmers realise the advantage of the destruction by fire of all diseased rubbish immediately after harvest. Of course, burning is not so necessary if the following crop is to be of a different kind.

Change of ground.—Of course, the ground beneath the diseased beans becomes charged with spores, and is, therefore, a possible source of infection. For this reason the bean crop should be moved to land not recently cropped with beans if this can be conveniently done.

Drainage.—Good drainage is advisable for many reasons; among others is the fact that moisture is favourable to the growth of the anthracnose fungus.

Choice of varieties.—There is much difference in the susceptibility of different varieties; but the susceptible varieties are precisely those which are most luscious, and which, therefore, bring the highest market price—at least among snap-beans. There is, therefore, little scope for choice of varieties.

It is useless, or nearly so, to treat the seed with bluestone, hot water, or any other preparation commonly used for pickling seed.



Bean-plant attacked by rust, *Uromyces phaseoli (Pers.)*, Wint. The leaves and pod are covered with raised dirty-brown diseased spots, round which one sees the torn epidermis of the bean. The brown powder is composed of spores.

II.—Bean Rust (*Uromyces Phaseoli* [*Pers.*], Winter).

Though the appearances produced on the bean-plant by the true rust-fungus bear less resemblance to common iron rust than those produced by anthracnose, still it is best, in view of the nature of the fungi causing the two diseases, to apply the term rust to the present disease. Bean rust is very common. It is to be found on plants here and there in most crops of beans. Occasionally, however, it develops into a serious disease that causes considerable loss. The fungus causing the disease occurs on all parts of the plant, more particularly, however, on the leaves; in severe cases it appears on the pods. The pustules of the fungus have a brownish, powdery appearance, and from them a brown powder can be removed on the finger. The brown spots vary in diameter from mere points up to an eighth of an inch. At first the fungus is under the skin of the leaf or pod; afterwards it breaks through, forcing the ruptured skin to one side, so that the torn edge surrounds the pustule on every side.

The remedies are the same as those just given for anthracnose, though much less stress is laid on the selection of seed, as the rust fungus is less likely to attack the pods.

Miscellaneous Crops.

ONIONS (*Allium cepa*).

A. A. DUNNICLIFF.

FEW of our farmers appear to realise the fact that as much money may frequently be made from 1 acre of well-tilled and good-conditioned land planted to onions as from 20 to 30 acres devoted to the usual farm crops. I know a good many farmers who this past season have pulled 10 and 12 tons per acre, which were sold at £15 per ton net—that is, clear of all expenses for carriage or sale; and these figures are by no means extravagant either for quantity of crop or price for early market.

For onion-growing absolutely clean culture is essential to the production of a paying crop, and it must be assured of due attention whenever required, irrespective of other farm work. Neglect of this will cause a large amount of extra work, which will not after all ensure a good crop. The grower will find compensation for this prompt and frequent attention in the fact that the care of the onion is really light work, and an excellent employment for those who cannot perform the heavy work of the farm.

Soils.

The soils best adapted for the growth of onions are found to be sandy loams or alluvials, or, as a rule, those soils which, while fertile, are light in structure. These give the most satisfactory returns in both quality and quantity, whilst, as we get upon heavier lands, so the crop will deteriorate in appearance and quality, and become less remunerative. Planted on wet or heavy lands the crop matures very late, if at all, and forms a large proportion of scallions. The land selected should be fairly level, that the finely-tilled surface may not wash in times of heavy rains.

Preparing the Soil.

It is of first importance that the land should be clear of weed-seeds, so that when the young onions come up they may have the soil to themselves, and not be choked by weeds. For this purpose it is better that onions should follow a root-crop, such as carrots or potatoes, the cultivation of which has destroyed all weeds for the season. Partly for the same reason, onions may very safely follow onions. The land should be ploughed immediately the preceding crop is harvested, and remain exposed to the weather for a time, which will improve its mechanical condition; re-ploughing or, preferably, cross-ploughing in the spring, and reducing to a fine tilth for a depth of (say) 6 or 8 inches. No labour should be spared to effect this object.

If turf or grass land is being taken in for this culture, it should be manured well and turned in with the sod in the fall of the season, the whole being allowed to decay and mellow before being re-turned; but every opportunity should be taken of scuffling off any surface weeds which may appear.

One very important point in preparing land for the growth of onions must not be here overlooked, and that is the necessity for a firm bottom for the roots; this greatly affects its general development, and to obtain this condition the land should be well rolled, to consolidate it before being drilled.

Manures.

This crop requires the very best of manure, and plenty of it, offered in the most tempting condition. Well rotted barnyard manure, combined with all the droppings of the farm animals, pig manure, poultry guano, wood ashes, bone meal, or bone dust, superphosphate, &c., alone or composted, are all good for the onion; as well as some of the special preparations by the local manufacturers. From 30 to 50 loads of *well rotted* manure may be judiciously applied per acre for this crop. Old lands will of course require to be kept up with manure, and by varying its application, the one soil may be sown to onions for several years in succession—an exception to the general rule. This is an advantage, inasmuch as the good cultivation necessary to keep clean the first crop is beneficially felt in the condition and tilth of the succeeding ones, and facilities are increased for the sowing of the early succeeding crops.

Sowing the Seed.

In this matter the first point to watch is that the seed is fresh, and reliable in germinating. It must be of *last season's growth*, seed two years old or more cannot be depended on with certainty at any time—and with all the care and labour to be bestowed on this crop, inferior or old seed is dear at any price—even as a gift—and the very best seed obtainable will be found the cheapest. It should be plump, of a black colour, and oily when pinched, and should germinate in three or four days. As a general rule 3½ lb. per acre is the average quantity required when broadcasted, but 1 lb. to 24 ozs. is sufficient if drilled. It is preferable to sow this crop in drills, and the extra labor entailed in this operation will be more than repaid in the facilities for hoeing and cleaning. Shallow drills, 1 or 2 inches wide, should be drawn, and all exactly the same distance from each other—say, 12 inches apart. The seeds may be dropped averaging 1 to 2 inches apart in the rows, and be lightly covered with half to an inch of soil. When the seed is planted by drills it is usual to have a small roller, say about 6 inches wide, attached behind the machine, to firm down the planted row. When a seed-drill is not on hand, other means should be taken to obtain the desired end. This firming of the soil, besides assisting the plant in its after-growth, also prevents the young plants being drawn out of the soil by frosts, as is frequently seen just after germination in light soils. The seed should be sown as shallow as possible, so that the growing plant may *sit on* the ground, *and not in it*, except the roots. Plenty of light and air are needed to develop fine, sound, symmetrical bulbs, of character and of good keeping qualities; hence the necessity for the solid bottom under them which I have just before referred to. It is well to sow as early in the spring as possible, so that the crop may have the full season to mature; but for those who wish to catch the early and best-paying market, sowings should be made during March, April, or May, and the land should be prepared accordingly. It is a noticeable fact that the autumn-sown crops generally escape the diseases to which spring-sown onions are subject.

Cultivation.

Consists chiefly in hoeing, weeding, and thinning out the young plants. The crop must be kept scrupulously clear of weeds, and the land friable and light. For these purposes—as well as for sowing seed—there are several admirable machines which reduce the labour to a minimum. The scuffle or push hoe may also be used with ease and advantage, especially in drilled crops. The thinning must be done with discretion. If the land is rich or has been heavily manured, the plants may stand thicker together in the rows (say) every 2 inches; on poorer soils more feeding space must be allowed. But it is well to bear in mind that medium-sized bulbs demand better prices in the city markets than very large ones, and a larger quantity of the former will pay better than fewer of the latter. When the tops begin to wilt and fall over it indicates the maturing of the crop, and if the crop is backward for the season, this process may be hastened by bending down the tops, causing the bulbs to develop more rapidly. Any plants which seem disinclined to form the bulb, or become what are called scallions (chiefly through an inferior strain of seed), should have the earth gradually withdrawn from them until they are quite uncovered, with only the fibrous roots in the earth. This process frequently forces the plant to bulb, which may be also assisted by the bending of the tops as before advised.

Harvesting.

The pulling of the crop should not be delayed after the tops are well dry, for if much rain should fall they will be apt to re-root, which is detrimental. The pulling should be done by hand, and the crop laid in windrows to dry, about three rows being put in one. Care should be taken that they are not bruised or injured, such ones being very liable to decay when stored. When the crop is thoroughly dry the bulbs feel hard when handled ; they may then be carefully gathered and carried to the barn—piled in heaps, or stored in lots not more than 2 feet deep. If the crop is to be marketed at once the bulbs should be topped at this stage, and all inferior ones rejected. If the grower wishes to keep for a late market the crop will keep better untopped.

Varieties to Grow.

The varieties most commonly in demand, and probably the easiest to grow, are Brown and White Spanish, Brown and White Globe, and James' Keeping Onion. These are always saleable, and may be preferred for main crops; the Spanish and Keeping ones being best adapted to sandy soils, and the Globes to those rather heavier.

The small pickling varieties are also equally saleable, and the small ones gathered from amongst the main crops readily sell for this purpose.

The Potato Onion is a variety also largely grown, and is valuable alike for the farm-garden, or field culture, inasmuch as it may be planted where seeds of the other sorts have missed, or for which land could not be properly prepared in time. The sets are planted singly, and the new onions are produced around the base of the plant, much like potatoes, hence their name. Being quick growers, they may safely be planted rather later than others. The old rule was, " plant on the shortest day, and gather on the longest," but if planted in the autumn they will yield good crops, and come in early for use when onions are scarce and dear.

The culture previously advised holds good with these also, *i.e.*, plant in good soil, allowing plenty of room between the plants (say) 12 or 15 inches, and keep clean from weeds, &c. They are mild in flavour, and very palatable.

Of the medicinal and food value of onions, both in the farm-home and other households, much might be said had we space, but we may briefly remind our readers that there are few, if any, better preventives of disease from exposure, such as all chest complaints, rheumatism, &c.; few better purifiers of the blood, and none more conducive to general health, from infancy to old age, than the invaluable onion, either raw or cooked. As an article of food, it is far superior to the potato, for whilst the solids in each are very similar, *i.e.*, about 25 per cent., the particular nutrient qualities of the onion are double those of the potato, and, as food or medicine, onions are worthy of a far more extended use in our homes than is now accorded to them.

In suitable soils and situations onions may be successfully grown in the Clarence and Richmond districts.

Mr. McKeown says:—A well-sheltered position possessing a rich, moist, well-drained, somewhat sandy soil should be chosen.

The land should be deeply ploughed, and thoroughly pulverised and compressed by rolling.

It is advisable that the situation chosen should be one which previously has been free from weeds.

In order to facilitate after working the seed should be sown in drills wide enough apart to admit of the passage of a Planet Jr. hand hoe, which will be found a most effective implement in destroying weeds in the early stages of their growth. Three pounds of seed will sow an acre. For the main crop in the north-eastern districts the seed should be sown in April and May, and when well above ground the plants should be thinned out to 6 inches apart, the surplus plants being set out in drills at similar distances.

In the light volcanic soils of the Richmond the seed should be sown about 2 inches deep as the surface soil becomes too dry to admit of the germination of seed except in wet weather.

The bulbs should be harvested before the tops have become quite dry, a few hours lying in the field being sufficient to dry them for storage till required.

THE TOMATO (*Solanum lycopersicum*).

A. A. DUNNICLIFF.

THE tomato was first introduced into England from South America just three hundred years ago (1596). For a long time it was only grown as an ornamental plant, or for its medicinal properties, and was commonly known as the love apple.

Its extended cultivation is of comparatively recent years, not more than fifty, but of late it has advanced so rapidly in public estimation as a most useful, wholesome, and delicious fruit or vegetable, that very large areas are annually planted with it. In America the production of early tomatoes is a distinct and profitable business, occupying thousands of acres; whilst scores of thousands of acres are cultivated for canning purposes only. Some of these canned goods are brought here, although the plant grows with us as freely as the rankest reed. Considering then the value of this condimental fruit, the very large number of ways in which it may be consumed, and the ease with which it may be propagated, we cannot wonder at its rapidly increasing popularity, nor yet help asking ourselves why more attention is not given by us to its production, which hardly keeps pace with the public demands for table alone. We want a larger supply of superior average quality, both early and late, for table; as well as enlarged quantities of good, sound, cheaply grown material for manufacturing purposes, such as jams, jellies, preserves, chutnies, pickles, sauces, &c., of which, too, a large proportion of our present consumption is imported.

All the work entailed in the management of this crop is of a light nature, quite suitable for young people and many persons who may be unable to do the ordinary work of a farm; and it is in the hope of assisting to fill these wants, and to utilise the help of this weaker section of our community, that the following cultural hints are written.

The best land for tomatoes is a rich mellow loam, with a little sand in the upper layer, and a good clay subsoil. For early crops a northern aspect is desirable. Poor and medium quality lands will frequently give early crops, but not quantity. Where this plant is to be grown in quantity for manufacture or the open market, or when quantity is of more consequence than earliness, the soil must be either naturally rich or artificially made so.

Having selected the land for this crop it must be prepared during the autumn previous to planting in the spring. If new land be taken it must be broken up and prepared with all the care advocated for onions and potatoes. If grass land is chosen, it must be well and deeply ploughed in the autumn, the sod well covered, and sown to rye; put on a good coating of it and all the farm manure you can get together for the purpose. Towards the spring, or as early as the rye is shooting for head, say about three feet high, get the plough in again, and put the rye under the ground, covering every green blade. This can very easily be done by using a good revolving coulter, or a sharp knife-coulter, and fastening a stout chain on the plough beam, allowing the other end to drag in the furrow, just short of the wing of the mould-board. Harrow down, and let it lie until planting time, by which time the green stuff should be rotted.

Planting in the open cannot take place until the district is clear of frosts unless means be taken to shelter the young plants every evening as the Chinese do. Meanwhile the young plants have to be got ready in a cold frame, or some warm sheltered spot.

The seed or plant bed may be made of any desired size, according to the extent of cropping. Having selected the spot, let it be dug or ploughed well over in the autumn. Then a good coating of well-rotted farm manure, put on at the rate of a ton or more, and a bushel of wood ashes or a peck of fresh-slacked lime to every 500 square feet (50 x 10) be forked or worked in. A frame of boards of the required size may be built on this plot, and covered with calico; the latter should be made to shift or roll up, as will be frequently needed. The seed may be sown in shallow boxes under cover, or in the frame, and covered with barely half an inch of soil. As soon as the plants are large enough to handle, two or three inches high, they should be transplanted into the frame, which by this time should have been worked up to the finest condition and tilth.

The plants may be set out, say 5 or 6 inches apart, both in rows and spaces, setting each plant opposite the space in the former row. Here they may remain and grow until time for transplanting into the field; and by removing the calico, giving them air, light, and sunshine on fine days, and covering up in the evenings or during cold spells or frosts, they should presently become stout and stocky plants. After they are once set out, don't give them much watering, or they may be inclined to draw up and become lanky and tender.

The main point in a frame or bed of this character is to keep it dry and warm, and in transplanting into it, care must be taken that the plants are not much lower than they sat in the seed-bed, as the deeper they are set the more liable to damp off. If any plants have got rather drawn in the seed-bed, and become long-shanked, they should be laid slanting, just below the surface, and they will take root along the stem, and become stout and stocky plants after all. The drier the bed is kept (with discretion) so the plants will root and grow. When they become five or six inches high, some will want to outrun their neighbours; these should be pinched in a little, so as to allow the weaker plants to come up uniform in strength before putting out. Any suckers that may appear should also be removed if it is intended to grow for early fruit.

When all is ready for removing the young plants into the field, they should have a good watering, some hours or the night before, so that the roots will retain hold of as much soil as possible. The earth may be cut both ways between the plants with a sharp spade or knife, and lifted underneath also. When the plants are lifted out, as much soil should go with each, as may remain with the roots, taking care not to break the fine rootlets, so that the plants may suffer as little shock as possible. A large number may be lifted, and carried out to the field at one time by using large board trays or other rough appliances made for the purpose. In fact the plants may be treated in every way the same as when transplanting cabbages, cauliflowers, celery, &c., either with the plough, spade, or trowel. Plant at least one inch deeper than in the frame, and if the quantity is not very large, evening is the best time for moving them, or after showers.

Unless the soil is dry, do not use water in the transplanting as they are liable to damp off in cold wet soil. They may need shading a little in the heat of the day for the first two or three days after moving, otherwise the more light and air they get the better.

It is better to plant 4½ feet or 5 feet apart, and stake them up as we do vines in a vineyard, instead of letting them trail on the ground, as some do. These latter hardly bear as well, and are far more subject to the usual diseases than those supported from the earth. The land should be kept clean between the rows and plants, as in any other well-tended crop. If it is intended to keep the plants well pruned throughout their growth, and for early fruit this will be necessary, 4½ feet will be found ample space in the rows, and 5 feet between the rows, but if quantity of crop is of more consequence than earliness, little or no pruning will be needed. Perhaps more particular information on this point may not be unacceptable.

Pruning should commence as early as suckers get to be an inch long, and these will appear frequently immediately the plants are set out in the field. If this tendency is not checked by their removal, the plants generally lose their first bloom, and earliest fruits. Some experienced growers prefer to leave one sucker and the main stem, some two suckers, and others the main stem only, until the first or second cluster where it will fork, then leave the fork or two stems.

If *early fruit* is the object, better prune to the main stalk only and then top it after three or four clusters are set. If early fruit and a good crop are wanted, five or six clusters are enough; if you want a heavy crop, and time is no consequence, don't trouble to prune at all; but if *earliness means money*, which it usually does, you must watch and prune always. Five tons of marketable tomatoes per acre from unpruned vines is a good crop, although twice this quantity has been frequently grown.

Speaking of early tomatoes, which in some cities fetch enormous prices, and good prices here, reminds me that on a recent trip to one of our northern rivers I found a lot of Chinamen growing tomatoes for the Sydney early market, and I learned on making private inquiries that they were each earning an average of £1 per day, and had been so doing for a considerable time. Now, if Chinamen can do this, is there any valid reason why our people cannot do quite as well, or rather, why they don't do it?

When working amongst the crop, any diseased plants or fruit should be immediately removed from the field when discovered and *burnt*, and after the crop is gathered the haulms or stems should be collected and burnt also. It is not advisable for tomatoes to follow a crop of tomatoes on the same land, at any rate without a crop or two of a totally different nature intervening. These precautions are necessary as preventive measures in the spreading of diseases.

Care should be taken when gathering the fruit that it be not bruised, as such are sure to decay rapidly. Those which are to travel long distances, or occupy days in transit, should be picked when they begin to colour at the blossom end or calyx.

When packing, the fruit should be graded according to size and ripeness, all in each package being as near alike as possible. The grading should be something like this:—

1. Large ripe fruit.
2. Small ripe fruit.
3. Large medium ripe.
4. Small medium ripe.
5. Large green fruit.
6. Small green fruit.

The fruit will thus look better, sell better, keep better, and pack or travel better, whilst the arrangement will be found advantageous to the buyer and more profitable to the seller, besides establishing a reputation for the brand amongst buyers. Each package must have the contents and quality faithfully marked on the outside, so that buyers may learn to rely on the brands without wanting to overhaul the fruit.

Culls should not be marketed, but fed to pigs or destroyed, as other refuse fruit.

For successive crops seed may be sown at intervals out in the open, after the frosts are gone. Prepare a bit of rich soil, and strike out drills not more than half an inch deep. Sow thinly, cover lightly, and water sparingly. The young plants should show up within a week; and if you wish to push them along, transplant into a nursery bed when they get their third leaf, putting them 5 or 6 inches apart as previously advised, and then follow on as before. Seed may be sown from June to end of January, and crops may be grown for eight months in the year, in some favoured spots even longer. An ounce of seed will furnish ample stock to plant an acre of land.

Varieties to grow.

The question of what variety is a matter of considerable importance, depending greatly on the purpose for which the crop is chiefly intended. Those grown for the very early market, for successional table use, or for manufacturing purposes will each require different sorts; and in the multitude of new kinds, each one eclipsing the last in its superlative merits, it is not easy to find the best for our purposes, and we can only fall back on those having stood the test of time, whilst being of standard quality.

This view is confirmed by recent letters from friends in America who are largely interested in the tomato industries. These say that a few of the old sorts, if not identical with, are quite equal for all practical purposes to some of those advertised under more impressive names. For instance, Mr. J. W. Day, of Crystal Springs, Mississippi, probably the leading authority in America on tomato-growing, puts "the old and well-known 'Acme' equal to or ahead of all other new varieties." This one I introduced to the Australian public eighteen years ago. Again, Mr. D. Cummins, the celebrated tomato-canner (or preserver), says that "after having tested every new variety as it came before the tomato-growing world, we have yet to find one that suits our business as well as the 'Trophy.'" This is also another old favourite with us.

To give a particular description of each of a number of varieties would be only suitable for a more elaborate article on this crop than is here intended; but I give a concise table of relative merits, by which a selection may be made from amongst what I may call the working aristocracy of the tomato. The list may not be infallible, but it is an honest expression of opinion, based on practical experience.

Unfortunately the opportunity of obtaining "thoroughbred" seeds, or seed carefully selected from high-class strains of these varieties, is seldom presented to the ordinary growers, and are obtained with difficulty.

In the list it will be seen that ten is the maximum number of points allotted to each quality. The letters M and D denote those which are best adapted for *market*, and those which are really *dessert* fruit, and more suited for private growers. Where both letters appear in the column, the variety is good for both purposes.

All ribbed and irregular skinned varieties are excluded, as being wasteful and facilitating the lodgment of disease spores.

Dwarf Champion and Dedham Favourite being very compact growers, may be planted 3 feet apart.

CLASSIFICATION OF TOMATOES.

Variety.	Purpose.	Earliness.	Size.	Colour.	Flavour.	Smoothness.	Productiveness.	Hardiness.	Total.
Acme	M.D.	10	8	10	10	10	10	10	68
Beauty	M.	8	10	10	10	10	7	7	62
Blenheim Orange	D.	8	10	8	10	10	8	8	62
Dedham Favourite	M.D.	10	10	10	10	10	10	10	70
Duke of York	D.	8	10	10	10	10	8	8	64
Dwarf Champion	M.	8	7	10	7	10	9	9	60
Essex Hydrid	D.	10	10	8	10	10	10	10	68
Favourite (Livingstone's)	D.	8	8	9	9	10	8	7	59
Golden Trophy	M.	10	9	10	8	10	9	9	65
Golden Queen	D.	10	5	10	10	10	10	10	65
Holborn Ruby	M.	10	8	8	7	10	8	10	61
Ignotum	M.D.	9	10	10	10	10	8	8	65
Market Favourite	M.	6	10	8	7	10	10	10	61
New Peach	D.	10	5	10	10	5	10	10	60
New Stone	M.	7	10	10	7	10	8	10	62
Optimus	M.D.	8	10	10	10	10	8	7	63
Perfection	M.	9	10	9	8	10	8	8	62
Sandwich Island	M.	8	10	9	9	10	8	8	62
Trophy (Cummins' strain)	M.D.	7	9	10	8	10	10	10	64

Diseases of Tomatoes.

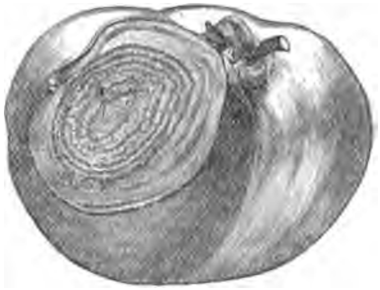
By N. A. COBB.

PIMPLY ROT.

THIS disease is caused by a fungus, which, growing in tomatoes, gives rise to somewhat sunken spots, often of large size, having the general appearance of the diseased spots on apples and other fruits caused by *Glœosporium fructigenum*, and commonly know by the name of "ripe rot."

As in ripe rot, so here the colouration of the diseased area is arranged concentrically. A well developed spot is greenish brown or black, for the most part. Near the edge, however, the colour is of a lighter or brighter tint that varies with the ripeness of the tomato; for if the tomato is still green, the edge of the diseased area is light brown or a somewhat dark reddish brown; but if the tomato is turning red, the edge of the diseased area is much brighter in colour—bright reddish brown or orange. The concentric markings appear to me to be caused by waves of fungus growth; and I am tempted to be more specific and say diurnal waves of growth. Each "ring" is marked by a separate outbreak of spores, as in the case of ripe rot.

The disease interferes with the form of the tomato, so that the area attacked is flattened or somewhat shrunken. The change from the healthy to the diseased tissue is distinctly marked on the surface of the fruit by a sudden depression or groove.



A tomato attacked by pimply rot. The disease appears on a flattened circular area in the form of concentric rings.

The colourless, ellipsoidal, thin-walled spores occur in immense numbers.

The spores break out in very minute pustules, better seen with a magnifying glass. These pustules give to the diseased surface a granular appearance, more particularly the older and dark part.

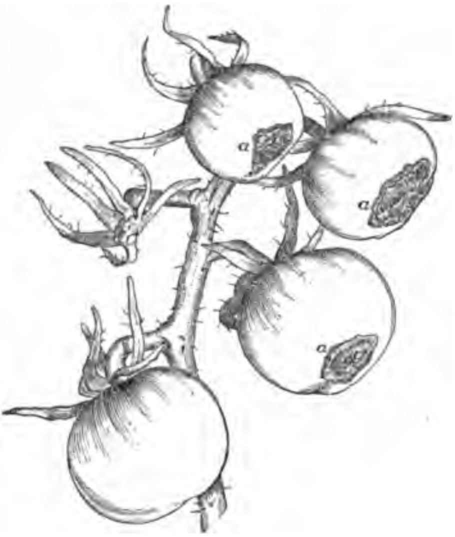
The only other disease with which the pimply rot is at all likely to be confounded is the black rot of the tomato, caused by the fungus *Macrosporium tomato*. The most striking difference is in the appearance of the diseased surface. In the case of black rot the diseased surface becomes *covered* with a velvety growth of a very dull dark green colour. In the disease here described there is no velvety growth, the skin remaining for some time glossy though discoloured.

Remedies.

1. Destroy affected tomatoes by fire. Such are worthless and only serve to spread the disease.
2. Avoid seed from all plants that have shown the disease.
3. Support the tomato vines on high trellis work. Though this does not absolutely prevent disease it helps to keep the growth hardy and healthy—lets in more air and sunlight, and ensures a better crop.
4. If this disease has been severe on a piece of ground devoted to tomatoes, remove the tomatoes next season to ground as far distant as practicable, and preferably higher ground.
5. See that the land is well drained.

6. It is barely possible that spraying with Bordeaux Mixture once in ten days from the time of blossoming will prevent this disease. If the spray-pump is being used for other purposes it would be well to try this.

BLACK ROT (*Macrosporium tomato*).



Tomatoes attacked by black rot (*Macrosporium tomato*). The rot is seen at *a a a*, spreading from the blossom end. The lowest tomato is not yet attacked.

This is the worst disease attacking the tomato, and is only too well-known to all who have grown that fruit. Dark spots appear first, usually at the blossom end of the fruit; these slowly enlarge until by the time the fruit is ripe it is spoiled—half or nearly the whole of the tomato has turned black and collapsed. The fungus that causes the trouble is a black, or rather dark green, growth, which gives rise on the surface of the tomato to dark green velvety-looking "cushions," composed almost entirely of spores. The form of these spores is well illustrated in the accompanying illustration.

Other fungi occur together with the *Macrosporium*, but they are of secondary importance, as they never occur except the *Macrosporium* has first appeared; they are not known to by themselves cause damage. Of these secondary forms no less than three are common. The first causes a whitish or salmon coloured growth on the surface among the dark green cushions of the black-rot fungus, and is a species of *Fusisporium*. The second is the common ripe-rot fungus, *Glœosporium fructigenum*. The third is the green mould, common on bread and old boots, *Penicillium glaucum*.

Remedies.

1. *The use of trellises.*—The black rot fungus grows best in a damp atmosphere, and near the ground. Hence, if the tomato vines are kept from the ground by a high trellis, or are tied to stakes, they suffer less. Merely trellising the vines will not prevent or stop the rot; it will only hinder it. A further precaution consists in cutting off the tops of the vines. This lets in more sunlight, and does not injure the vines if they are growing thriftily. Both the above measures should be adopted regardless of disease; but we have noticed that tomato-growers frequently neglect them.

2. *Choice of varieties.*—Some varieties of tomato suffer less than others, though there is no variety known that is proof against the disease. The smoother varieties—that is, those having no creases—generally suffer least. These smooth-skinned, nearly spherical sorts are also superior, so there is a double reason for growing them.

3. *Burning diseased fruit and vines.*—Never allow rotten tomatoes to lie about; gather and burn them as soon as they show signs of disease, which is

often when they are no larger than peas. This precaution is one that undoubtedly pays. Nothing less than the complete destruction by fire of the diseased material will answer; burial is not recommended.

4. *Drainage.*—The disease is usually worse on undrained land. Good drainage is therefore advisable.

5. *Choice of seed.*—Never use seed from diseased tomatoes, or, if it can be avoided, from vines that have shown the disease.

6. *Change of ground.*—When the disease has been bad on a given piece of ground it is not advisable to plant it again with tomatoes for a season or two. A better crop of tomatoes will be obtained by putting the crop on other ground, if such that is suitable can be had.

7. *Spraying with Bordeaux Mixture.*—The beneficial results of spraying tomatoes for black rot are still questionable. Spraying the fruit after it is once attacked is nearly useless. On the other hand, some good appears to result from spraying the young vines, and then periodically once in two or three weeks. Spray in particular the young fruit. I would not, at present, advise a grower to invest in a spraying machine with a view to making greater profits through spraying his tomatoes; but if he already has a spraying machine, or has other crops that it would be profitable to spray, I should, without hesitation, advise spraying the tomatoes as recommended above, if it can be done at the same time as other spraying (*vide* p. 340).

In general, then, it will be seen that the measures recommended to be taken against the black rot of the tomato are such as can be based on what we know about the fungus that causes the rot. Destroy this fungus whereever it can be seen, and be very suspicious of any vine or piece of ground where it has appeared. The spores are small and invisible, are produced by thousands, and are easily spread by the wind, by water, and by cultivation; they have great vitality, and thrive best where it is moist. These facts show why it is best to trellis, trim tops, and drain, as well as the reason for removing to new ground.

PUMPKINS, SQUASHES, MELONS, &C.

Dry Districts.

G. VALDER.

For feeding milch cattle, pigs, &c., and as a vegetable, this class deserves some attention, and the following directions should be of value to intending growers:—

Choose if possible a light soil with good drainage for this crop. Sandy or even stony ridges are very suitable. Plough deeply and bring to a fine tilth.

Plant the seeds in hills* 10 feet apart each way, putting five or six seeds in each hill a few inches apart, and thin out the plants to two in each hole.

Work well between the hills with a cultivator after every heavy rain, so that the soil is thoroughly loose.

Provided that the land is kept free of weeds and well loosened up, very large crops of pumpkins, squashes, vegetable marrows, melons, and cucumbers can be obtained even in the driest season.

When possible, well manure the land for this crop, as plants of this family are gross feeders.

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* The "hills" should not be raised above the surface of the surrounding soil. In dry districts the flat system of culture is the most effective.

Among the best varieties are:—*Pumpkins*—Crown, Ironbark, Button, Turk's Turban; *Squashes*—Hubbard, Delicata, Pike's Peak, Mammoth Warren; *Water-melons*—White Gem, Cuban Queen, Kolb's Gem, Seminole; *Rock-melons*—Cassaba, Emerald Gem, Banquet.

Coast Districts.

G. M. McKEOWN.

Melons.

In favourable situations in the warmer parts of the Colony melons may be grown for the early metropolitan market, but it is only in the earliest part of the season that the prices will compensate for very long carriage.

A sandy loam in a warm situation should be chosen, the land being deeply worked.

The seed should be sown in "hills," the surface not being raised, about 8 feet apart for water-melons, 6 feet being sufficient for rock-melons, five seeds being placed in each hill, and when the plants are well established two or three should be removed, the strongest being retained.

For early melons the seed should be sown in a warm spot, with bottom heat, in June and July, and when transplanted carefully protected at night.

The plants will require plenty of water and manure, and a strict watch should be kept to prevent their destruction by insects. For the latter purpose they should be freely "dusted" with air-slacked lime, ashes, or soot, in the early stages of their growth.

The vines should be pinched back and trained at the start so as to form a thick covering over the roots, which will assist them to resist dry, hot weather, and increase the production of fruit.

For the Sydney, or other distant market, rock-melons should be packed in ventilated cases, of a convenient size for handling, the fruit being well protected with dry grass or straw.

Pumpkins, Squashes, Marrows, Grammas.

For the local market and household use, and for food for stock of all kinds, pumpkins should be largely grown, as when once fairly started and beyond danger of destruction by insect, the vines require but little attention.

A deep free loam, rich in vegetable matter, is the best soil, and this should be deeply and thoroughly worked before planting.

In order to facilitate after-cultivation by means of harrow or horse-hoe, the hills should be placed 8 feet apart, which will admit of light tillage being carried out till the vines become too large for the passage of a horse. After this, if the land has previously been kept clean, weeds will not give much trouble.

Squashes and marrows should be treated in a similar manner, but for the bush varieties the distance apart may be reduced to 6 feet.

As the vines suffer greatly from the attacks of beetles, frequent applications of lime, wood ashes, or soot will be found necessary.

Cucumbers.

To produce early cucumbers for the Sydney market the seed should be sown in June or July, in a warm corner with some bottom heat, and when danger of severe frost is over the plants should be transferred to the warmest situation available and protected by covering at night.

The soil should be deeply worked, and a liberal supply of well-rotted stable manure thoroughly worked into the hills, which should be placed about 6 feet apart.

The plants should be mulched and well watered, if the weather prove dry, and as high winds are prevalent in the spring the vines should be secured in position by means of pegs, otherwise they will become matted and twisted together.

For the Sydney market the fruit should be carefully packed in layers separated by fine dry straw, in cases having a capacity of about a bushel, and constructed so as to admit air.

Pumpkins, Squashes, and Melons

Suffer principally from the attacks of leaf-eating beetles. *Aulocophora hilaris*, an active black and yellow beetle (Fig. 1), is particularly destructive to pumpkins, doing much the same damage as the twenty-eight-spotted Epilachna (Fig. 2). E. twenty-eight punctata, a beetle closely related to the ladybirds, but differing from them in habits, the latter being carnivorous and living on scales and aphides, and never eating leaves.

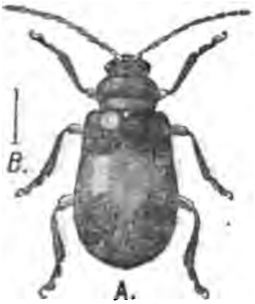


Fig. 1.—The Banded Pumpkin Beetle (*Aulocophora hilaris*, Boisd.

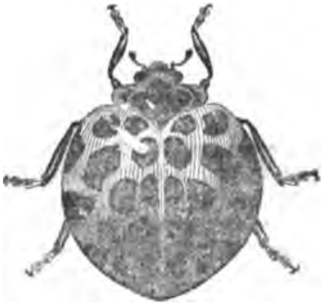


Fig. 2.—(Epilachna 28 punctata, Fabr.), 28 Spotted Lady-bird.

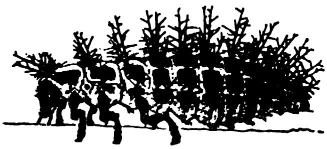


Fig. 3.—Larva of Epilachna (side view).

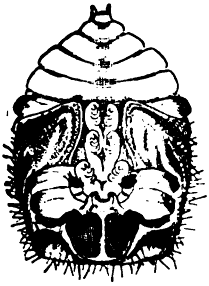


Fig. 4.—Pupa of Epilachna, with larva skin or covering removed. (Magnified.)

Remedies.—Paris green in proportion 1 lb. to 160 gallons water, or a little lime or ashes dusted on the leaves.

Aphides.—Thousands of these are often found upon the leaves of vines. They frequent the undersides. The most practical way when the young vines are attacked (and it is only then that curative treatment would be payable) is to gather in the lateral growths, and cover the whole plant with an inverted tub, under which fumes of carbon bisulphide are allowed to evaporate.

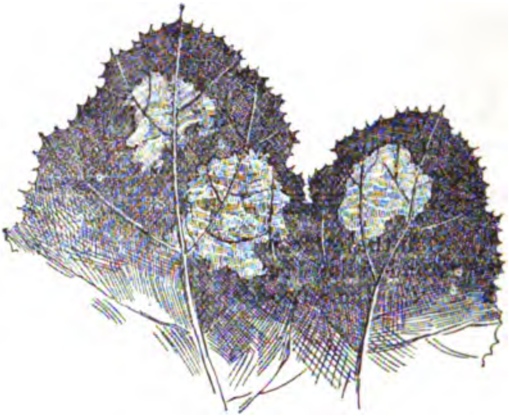
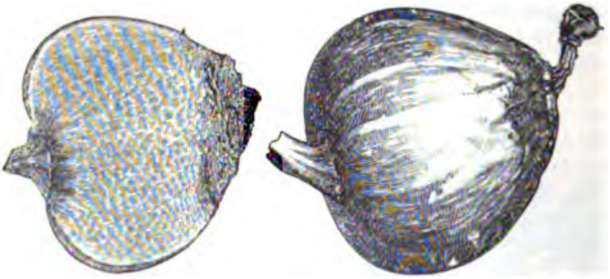


Fig. 5.—Pumpkin-leaf showing ravages of Epilachna.

Pumpkins and squashes are often tackled by crickets, and nothing is better for this form of attack than poison-baits of bran, Paris green, and treacle.

Squash-blossom and Squash-tip Diseases.

This blight is one that is very fatal to squashes. The first indication the grower has of its attack is the appearance of a dark colour near the tip of the young squash where the withered blossom still clings. This colouration extends backward as the squash grows, and long before it is ripe the squash is a worthless rotten mass. The colour of the rot, as it shows on the surface,



A squash, showing the effect of the squash-blossom and squash tip-disease. The right-hand figure shows a squash whose tip is discoloured and rotten on account of the attacks of the disease. The left-hand figure shows the same squash cut open, so as to display the progress made by the disease among the tissues of the young squash; the diseased tissue appears spongy and darker coloured.

varies according to the variety of squash. Near the base of the withered blossom the colour is black or dark-green and velvety, and it is here that the surface of the fruit first becomes shrivelled and wrinkled. A little farther from the tip of the fruit the rot is dark-brown, and this shades off through light brown into the healthy colour of the rind of the fruit. This description is of a half-rotten squash about half-grown. When the destruction is more rapid, and the squash is killed while very young, the appearances are somewhat different.

The cause of the disease is a fungus belonging to the old-fashioned genus *Macrosporium*, and the dark-green velvety appearance caused by it as described above, closely resembles the appearance caused by the black-rot fungus of the tomato, which fungus belongs also to the genus *Macrosporium*. The microscopic appearance of the fungus of the squash disease is set forth in the accompanying figure. When split in halves so as to show the changes in the flesh due to the disease, all that portion of the squash near the tip is seen to be discoloured and spongy. Where the flesh is sound it presents the characteristic orange colour of healthy squash; but near the tip, where the outside was seen to be discoloured by the rot, the flesh has changed to a brown or ochre colour, and is less solid than elsewhere. The mycelium, or "roots" of the fungus, extend as far as the brown or ochre colouration, and is found more particularly near the surface, and in connection with the fibro-vascular tissue.

Accompanying the dark-green felt produced by the fungus just described one usually finds a snowy-white or pinkish growth on the surface of the rotten part of the squash. This snowy appearance is due to a growth of spores of a very different appearance, and therefore formerly always referred to a distinct species of fungus. These spores occur in patches among those of the so-called *Macrosporium*.

The constant occurrence together of these two sorts of spores admits, *a priori*, of either of two explanations, viz.; (1) Either they are different spore-forms of the same mycelium, and are therefore to be classed together as belonging to one species, or (2) they are two separate species, one of which is parasitic on the other, or at least finds its favourite nourishment only in the presence of the other.

Remedies.

No remedies have, to my knowledge, been devised against this disease. Dr. Cobb suggests that as the disease manifests itself almost as soon as the blossom has set, that such blossoms be pinched and prevented from fruiting.

Pumpkin-leaf Oïdium (*Oïdium erysiphoides*).

Well known to all growers of pumpkins, squashes, and melons is the white and powdery or mealy fungus which blights the leaves, causing them to turn first yellow, then brown, and finally to die. The fungus, which belongs to the group of fungi known as *Erysipheae*, or in other words the Oïdium group, is, like its relative the vine oïdium, mostly external.

Remedies.

1. Burn, or otherwise destroy affected material where practicable. Do not plough it in.
2. Practise a rotation of crops. Do not grow pumpkins two years in succession on the same land. When possible, put them on new land.

3. I have combated this disease with entire success by using flowers of sulphur, as for oïdium of the vine. The best results were obtained by applying the "Crown" brand of flowers of sulphur when the sun was hot. I found I had to be particularly careful to hit the lower surface of the leaves.

4. Bordeaux Mixture is beneficial when applied to pumpkins suffering from this disease. [N. A. Cobb.]

BROOM CORN OR BROOM MILLET (*Sorghum vulgare*, PERS.)

BY G. VALDER.

Preparation of the Land.

SELECT a piece of land, if possible, fairly sheltered from strong winds, as sorghums sown in drills are easily blown down, and thus cultivation between the rows is made difficult. Plough deeply, and bring the soil to a fine tilth with harrows or cultivator.

Sowing.

September and October are generally the best months for sowing, but growers can best be guided by sowing at the same time as they sow ordinary sorghums or maize. Sow thinly in drills from 2½ to 3 feet apart. From 4 to 8 lb. of seed per acre is required.

Cultivation.

When the young plants are from 3 to 4 inches high, thin them out with a small hand hoe to 4 inches apart. Cultivate between the drills with a Planet Junr., or similar horse-hoe, keeping the soil loose and the weeds down. When hoeing, after plants are 18 inches or 2 feet high, care must be taken not to work too deeply or too near to the plants, or the surface roots will be injured.

Topping.

This is a most important operation, and on it depends to a great extent the future value of the crop. When the plants are just commencing to form their seeds, that is, just after flowering, the heads are bent right down, breaking them about 6 inches below where the head branches. This operation will not affect the future growth of the plants, as the heads do not break off but simply hang down, touching the stalk. The seed becoming heavy as it matures, draws the branches of the head down, thus causing them to grow long and straight. From a trial made at Wagga Wagga I am convinced that a man could easily "top" 5 acres of broom corn per day, and therefore it is not an expensive operation. When the heads of broom corn are not turned down they become branched and crooked, and are of little value.

Harvesting.

The heads should be cut as soon as the seed hardens, that is, before it is quite ripe. They are then slightly green, and are much tougher than if cut when quite ripe. Cut the heads off at the bend where they have turned down, and trim them so as to leave about from 4 to 5 inches of stalk below the heads. Sort the heads into three grades—long, medium, and short. Thresh off the seed and pack in bales. They are then ready for market.

"TOPPING" OR TURNING DOWN HEADS OF "IMPROVED DWARF" BROOM CORN.

In October, 1894, I procured seed of four varieties of broom corn and cultivated them in a similar manner to the above. The results obtained were as follows:—

Variety.	Height.		Yield of Broom-heads per acre.		Yield of Seed per acre.
	ft.	in.	cwt.	qr.	Bush. of 60 lb.
Improved Dwarf	8	6	14	2	28
Californian Golden	9	0	19	1	32
Evergreen	9	0	16	1	28
Common	9	6	23	2	37

Samples of the heads of these varieties were submitted to a number of Sydney manufacturers, who valued them at from £18 to £20. One merchant told me that he had not seen finer samples in the Colony, and that he would be prepared to take at least 150 tons of the same the following season.

The yield obtained was a heavy one, the plants having very heavy heads I have noticed on the Hunter River, where this crop is largely grown, and in other coastal districts, that the plants make a very tall growth, but do not bear such big heads as those grown inland. This was especially noticeable at the Royal Agricultural Show, where samples were exhibited from the Hawkesbury, Richmond River, and other coastal districts, but in no instance were these samples fit to be compared with that grown at Wagga.

This crop is being grown largely in some parts of the Colony, but unfortunately little care is given to the crop, and as a consequence large parcels of broom-heads are being sent into the market which are of little or no value. A merchant told me that he was prepared to buy large quantities of good quality broom-heads, but that the rubbish now being sent into the market was not worth more than from £3 to £5 per ton, whereas he would willingly give from £18 to £20 per ton from broom-heads of the same quality as that grown at Wagga. He attributed the bad quality of much of the broom-heads being sent in to the farmers omitting to "top" their crops, and to poor cultivation.

I do not advise farmers to grow large quantities of this crop, as the industry would soon be swamped, but there is no reason why sufficient heads should not be grown here for the consumption of the Colony. Manufacturers have to pay from £18 to £25 per ton in California for broom-heads, and then pay freight and other charges before they are landed here. I have often seen a few days after the arrival of a steamer from California enormous piles of bales of broom-heads standing on the wharf just landed from the steamer, and Americans and other business people have remarked to me, "What is the matter with the farmers here that this state of things should exist?"

The crop of seed obtained would, if fed to pigs and poultry, pay all the expenses of the cultivation of the crop, and the broom-heads would represent the profit. I am confident that at the least from 10 to 15 cwt. of heads per acre can be obtained, and this, at its present value of £18 per ton, would mean from £9 to £13 10s. profit per acre.

Specimens of the varieties grown at Wagga, both in seed and ready for the market, were shown at several of our leading Agricultural Shows, where they attracted much attention.

Any district in which maize or sorghum will grow is suitable for the cultivation of this crop, and therefore the area available in this Colony is very large.

North Coast District.

By G. M. McKEOWN.

Owing to the excessively wet seasons which visit the north-eastern districts, it is necessary that this crop be sown early to ensure it being cured before the periodical summer rains set in.

The best time, therefore, for sowing is from the middle of August to the middle of September. If sown with a drill, from 5 lb. to 7 lb. of seed will be sufficient for an acre. The land should be deeply worked and brought into a fine condition, and the seed sown in drills opened 3 feet apart. The plants should be thinned out, leaving strong plants at about 4 inches apart, any greater space causing the production of coarse heads.

When the heads have fairly emerged from their sheaths, the operation of "bending" or "topping" should be performed; and, after this, in order to secure the crop before wet weather should set in, the heads should be cut and placed in the drying shed as soon as the stalks, about 6 inches below the head, will resist a firm pressure between the fingers and thumb.

To leave the heads to ripen seed, as may be done in drier climates, would risk the loss of the crop.

The heads should be cut with 6 inches of stalk, and placed in racks in the drying shed; and, should fungus appear on them, they should be exposed to the sun for a short time, and turned frequently.

Until quite cured, the heads should be turned often, so that all parts may be equally dried.

A local market is available, and millet of superior quality will always find ready sale in Sydney, as, so far, insufficient to supply the demand has been produced.

OSIERS.

WILLOW cuttings are usually planted in rows 3 feet apart, and 3 feet apart in the rows. They are allowed to grow in this way for three or four years until the plants become too crowded when every alternate row is cut out, also every alternate plant in each row, which will leave 6 feet between each row and plant. The cuttings are best planted in the autumn, and, if all goes well, the first cutting may be made twelve months after. Neither the first nor the second cutting will be bulky, but after this fair annual crops may be expected. When the plants are in full bearing, about 5 or 6 tons of stems may be cut from an acre; but of course when they are dried and ready for market the weight will not be more, and often less, than one-third of this. The cultivation of willows in a systematic way would be a payable undertaking in this Colony.

THE CULTIVATION OF TOBACCO.

(Compiled from "Tobacco as a Farmer's Crop for New South Wales," by G. F. Sutherland.)

THE successful culture of this crop for a period of more than sixty years in various parts of the Colony has very fairly demonstrated that a number of the many varieties known to commerce have found a congenial home within our boundaries. Some of them, under the favourable circumstances necessary to their proper development, have commanded the esteem of connoisseurs, and gone some way towards demonstrating the possibility of a successful prosecution of the industry among us; while the remainder, owing to error in selection, defective cultivation, or faults of treatment in the preparation of the mature leaf, have brought the product into some discredit.

Pipe Tobaccos,

A term which explains itself, are the product of any variety, but chiefly of Virginian, grown on deep, rich, alluvial, or loamy soils, containing a high percentage of humus and inorganic matter, such as lime, potash, &c., in a readily accessible form. They do not require proximity to the sea for their successful production, and demand a moderately high temperature. A varying but not heavy rainfall, particularly in the early period of their growth. May be raised by irrigation, but generally at the cost of quality and texture, and are principally and most successfully cultivated within the limits of the 25th and 45th parallels of north and south latitudes, thus pointing out the whole of our Colony, where suitable land exists, as a field for the production of these tobaccos.

Cigar Tobaccos

Of a high class are exclusively the product of the Tropics, and then only in limited areas can be found that happy combination of circumstances necessary to its perfect production. The requirements are a rich soil, in perfect physical condition, a high temperature, modified by proximity to the sea, and a humid atmosphere. Cuba, Sumatra, and the Philippines are the most celebrated producers, and the greater the similarity of any locality to these countries in the foregoing necessary conditions will also be its chance of producing a good cigar tobacco. As previously suggested, the banks of our northern rivers are most approximate to the above requirements; and if efforts fail to quite realise the high standard aimed at, the result should still be a very profitable one, as prices for this class of tobacco mostly range high.

Cigarette Tobaccos.

The chief favourites in this class are solely the product of the Levant and the countries bordering thereon. They are grown from a number of local varieties of Turkish tobacco, the names of some of which I have furnished. Their leaves are kept small by the system of close planting practised, which will similarly affect any variety, and is also credited with influencing the aroma. This latter, however, we take leave to doubt. These tobaccos might be successfully acclimatised in the higher lands of the coast districts of New South Wales, with considerable chance of their retaining some of their valuable characteristics. The pick of American bright (golden leaf) tobaccos are also used for this purpose, but do not command either the admiration or the price of the Turkish article.

Land intended for tobacco cultivation should be a deep, rich, friable soil, dry and warm from good natural or artificial draining, sheltered, and with a north-easterly aspect if possible. Such a position, affording the maximum of sunshine, is an important factor in producing an early as well as a good crop. Cold, wet, or tough and clayey soils, and those generally answering to the Colonial term of "glue-pot" lands, are quite unsuited for tobacco-growing. This plant, above all others, requires a loose soil that may be easily traversed by its tender rootlets, which free condition depends equally upon its constitution and the industry of the farmer.

A soil fairly rich in decayed vegetable matter best ensures this necessary friability, as well as affording a large proportion of the food requisite to build up the plant, to complete which must be added a proper proportion of potash, lime, magnesia, phosphoric and sulphuric acids. The two former are taken up by the tobacco-plant in large quantities, and are essential to its good quality as well as to its proper combustion in the manufactured state.

It is also found that the fertile, undulating, chocolate lands of the north-east coast will be better adapted to the production of a fine ribbed and veined, silky-textured, aromatic cigar tobacco than the low-lying rich alluvials.

Preliminary Cultivation.

Even where winter cropping may be practicable, land that is intended for tobacco should be allowed to remain fallow some months before planting, to permit of its proper preparation. It should receive one ploughing in May not less than 9 inches deep, and one every month or two months afterwards till the period of planting arrives, when a subsoiler should be used, or failing that a second plough, having its mould-board removed, should follow up the furrow, at a depth of 4 inches or so. This will either bring an entirely new stratum of soil under the action of the plant, or, in the case of old fields, land that has had a considerable rest. The benefits to the soil of these repeated ploughings are too universally understood to require justification here. Among others they are intended :—

To improve the friability of the soil by breaking up its parts, thus enabling penetration by the roots of crops in search of sustenance.

To increase its capacity for the absorption and retention of moisture.

To expose the particles of the soil to the disintegrating and dissolving influences of frost, sunshine, and rain by which their constituents are rendered fit for plant-food.

Besides which, both weeds and the eggs of insects come to grief in these operations.

The final ploughing should be accompanied by a good rolling or clod-crushing and harrowing, so as to reduce the field to as fine a tilth as an onion-bed, in which state, other conditions having been attended to, it is ready to receive the seedling.

Disease.

Before entering upon the practical details of cultivation of the plant it will be advisable to refer to the subject of disease which has proved the most serious evil tobacco-growing has had to contend with in this Colony. Although widely diffused it is but little understood by farmers, and it is hoped the following observations and suggestions may help intending growers either to suppress this ubiquitous evil or considerably lessen its injurious effects.

The tobacco "Mildew" or mould is a fungoid disease which has been known for the last forty years, both here and in Victoria. Apart from the destructive attacks of insects, which, through the medium of the spray-pump and insecticides, may be cheaply, summarily, and effectively dealt with, it seems to be the only serious complaint from which the tobacco-plant suffers. The disease appears in the form of a powder or mildew on the leaves, particularly on the underside, and especially on the young plants. It is an irregular and troublesome visitor, and has appeared in a malignant form at times. The most favourable conditions of weather for the successful propagation of this disease appear to be a wet and cold spring, with the alternation of hot sunshine and chilly nights. A deficiency of lime and potash in the soil is also supposed to exercise a favouring influence on the development of this as well as other fungi. A modification of this condition, with the application of proper safeguards against the adverse weather complained of, may, therefore, be justly supposed to be advisable precautions. The disease and its probable remedy have seriously engaged the attention of the Department of Agriculture from its inception, and Dr. Cobb, Pathologist, as a result of his investigations, advises the application of Bordeaux Mixture (*vide* p. 340) in the form of a spray as soon as the plants appear above ground, and once in every ten to fourteen days throughout the season of the year when mildew is destructive.

Seed-beds.

Bearing in mind the severe blows which tobacco-growing has in the past received from the forementioned disease, the necessity is impressed upon the farmer of exercising the greatest care in selecting the situation for his seed-bed, on the successful culture of which the very existence of a future crop depends. This may be done to a great extent by avoiding any locality where *mould* has been known to have recently existed.

In the past, convenience largely dictated the habit of making the seed-beds close to the intended tobacco-fields, which, if mildew be non-existent, is a very good arrangement indeed. But as the flats devoted to tobacco-culture are throughout the periods of seed germination and early growth of the plant—July till October—generally shrouded in a veritable wet blanket of fog, from sunset to some hours after sunrise, they afford the most favourable conditions for the development of fungoid growths. For this reason that position should be shunned, and intending growers are advised, even at the cost of some inconvenience, to select a higher and healthier situation beyond the prejudicial influences referred to. A sheltered nook on a hillside, with a north-easterly aspect, well drained, but with no washaway, will best answer the purpose. Plenty of such spots abound wherever tobacco is grown in this Colony, and having selected your ground proceed as follows:—Two or three months before sowing break up the land intended for the seed-beds to a depth of 18 inches, cleaning out all weeds, stones, and rubbish, and as the uplands recommended are generally deficient in the humus necessary to the free uncakeable soil and exceedingly fine tilth required for this purpose, it should be added in the form of a well-rotted pig-yard, fowl, or cowshed manure. That from the stable is not so suitable. This should be dug in and well mixed with the soil, in which condition, save for any necessary weeding, it may remain until the arrival of sowing-time. It should then receive a final digging and be laid off into beds, a convenient size for which is 16 ft. or 18 ft. x 8 ft., with 18-in. pathways between, the soil from which, to a depth of 6 inches or 8 inches all round, should be thrown upon the proposed beds. This elevation, coupled with the site, should afford perfect drainage. Upon the beds so prepared pile light brushwood to a height of 3 or 4 feet and burn off. A fairly strong fire of 45 to 60 minutes duration, while the ground is *dry*, will prove sufficient. Recent observation goes to show that where "brush" firing of the seed-bed ground had been properly performed, no "mildew" appeared, although it was universal on contiguous land. Having removed the charcoal and cinders, the ashes should be well mixed with the surface soil, and the whole carefully smoothed, for which purpose a fine-meshed long-toothed rake is best. This burning answers the double purpose of supplying potash in the form of ash to the soil, and the killing of grubs, weeds, fungi spores, and other obnoxious matter, which, if left unmolested, would cause considerable injury, and entail much tedious labour for their removal. Weeding a seed-bed means disturbing the tender roots and seriously interfering with the growth of the seedling.

The general fashion among tobacco-growers in calculating the area of seed-bed required is to allow 1 square inch to each plant, and sow double the estimated space, which is a safe and sufficiently liberal plan to meet all reasonable contingencies. However, it is better to err on the safe side, and have too many plants than too few. Beds of the area recommended will afford easy growing space to about 7,000 healthy vigorous seedlings. The sowing should be done at intervals of a few days, so that the maturing of the seedlings may be distributed over a period that will give the grower ample choice of time for the operation of planting, as well as enabling its accomplishment in instalments, conditions which will also be transmitted to the full-grown plant, and give more time for harvesting. Sow as follows:—To each bed take about two teaspoonfuls of seed, and having thoroughly mixed it with a quart of clean, fine, river sand, sow uniformly over the plot, or in shallow finger-drills across the width of the bed 4 or 5 inches apart. After this has been done, if the weather be dry, it may receive a light watering from a fine rosehead can, and the surface should then be firmly beaten down with a flat board or the underside of a spade. This operation is important, and should never be omitted. As no feasible precaution likely to prevent mildew should be neglected, it will be advisable to scatter a thin layer of common chimney soot over the hardened surface of the bed. This matter has a mechanical as well as a chemical action, to one or both of which is ascribed the power of destroying certain forms of fungoid life.

Dusting the bed with sulphur may be equally advantageous. No raking or other process is necessary for covering the seed. If the beds are liable to the incursions of poultry or cattle they should, of course, be securely fenced.

As frosts prevail over the greater part of the Colony during the period that the seedlings are being raised, it is necessary to take precautions against its possible attack. Several methods of protection are in use, such as the spreading of rushes and straw over the beds. Whatever merits these preventives may have in other countries, the practice is not recommended in New South Wales, as, on account of the close contact of the rushes with the ground, it effectually prevents the access of either air or sunshine to the seen or plant, harbours insects, and after the periodical waterings the consequent evaporation chills the ground. This both retards growth and encourages fungi, the spores of which there is every reason to believe have been largely distributed by this custom and the habit of using these contaminated rushes during successive years.

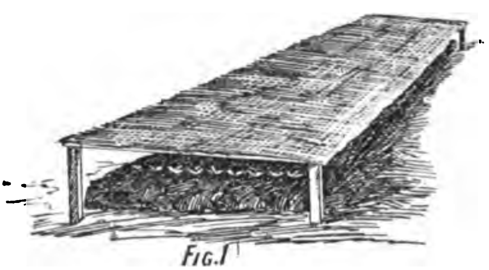


FIG. I

A much better plan is to well cover the beds with sets of light straw or grass mats, as sun-shades or frost and bad-weather protectors (Fig. 1.) They should be supported on horizontal poles, running along the sides of the beds a few inches above the ground, these being in turn upheld by small forked sticks, which should be higher on one side than on the other, say 5 inches and 9 inches respectively, to permit the rain to run off. The slope of the mats should be towards that side from which wind and weather are most to be expected. These screens are very easily and inexpensively made of split sticks or laths covered with grass or wheat straw, and should be large enough to overlap the bed, when they are an effective protection against frosts or a too powerful sun. They permit a free access of both light and air, the oxygen of which is as necessary as warmth or moisture to the existence of the plant, thus encouraging the growth of healthy hardy seedlings. They are also easily removed when the favourable state of the weather permits, which should always be done.

A cheese-cloth screen stretched on a suitable frame (*vide* Fig. 2) is also a good and handy way of protecting seed-beds.

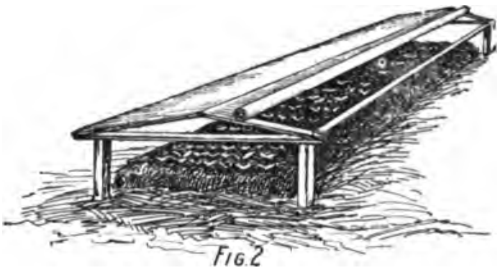


FIG. 2

The beds must be kept moist but not wet, nor at any time exposed to frost, rain, or strong sunshine. Watering should always be done in the evening, or early morning, delivered from a fine rose, held low so as not to disturb or wash away the soil from the tender rootlets. On the appearance of the young plants, which period varies, according to latitude and elevation, from one to six weeks from time of sowing, the shades should be removed and the plants carefully examined once if not twice a day, when insects ought to be searched for and rigorously destroyed, any weeds being also rooted up, replacing the shades when desirable. A week or two later surplus plants should be taken away, and if carefully pricked out in a spare bed prepared for the purpose will thrive very well,

If left growing too closely they become spindly and crooked in the stem and never develop properly. Should slugs or small insects now make their appearance they may be destroyed by a spraying of Paris Green.

It is at this stage "mildew" has been found so destructive heretofore, but it is sanguinely expected that if the precautions suggested for the spraying of the young plants with either of the fungicides recommended by Dr. Cobb, and the instructions as to site, preparation, and the care of the seed-beds here given are strictly attended to, the "enemy" may be kept indefinitely at bay. A strong man will withstand disease better than a weak one, and the same fact is equally true of plants. If at this stage they are periodically treated to a watering with liquid manure, prepared either from Peruvian guano, Sugar Company's No. 5 manure, or a mixture of three parts fowl-droppings to one of wood ashes, with a small teaspoonful of powdered sulphur to a gallon of the liquid, they will be found to make great strides in growth and vigour, and arrive at maturity much quicker than they otherwise would. Care should be taken that the various liquid manures are not supplied too strong or too cold, in either of which conditions they will kill or damage the plants. Of the latter compound, 1 lb. of solid to 1½ gallons of water answers very well. No. 5 manure and guano may be mixed at the rate of about 2 oz. to the gallon. A good way of obtaining a suitable temperature for the above is to expose the cans containing them to several hours sunshine. The strength not being exhausted from either sediment, it may be used for the kitchen garden or any other similar purpose. Seedlings are large enough to transplant when their leaves have attained the diameter of a penny-piece and are four in number. The sooner planting is done after the seedling arrives at this stage of maturity the better, as the older and woodier stemmed they get the greater is the difficulty they find in establishing themselves when uprooted from the bed and set out in the fields. For a fortnight prior to this period they should be toughened by exposure to the normal atmosphere, shades only being used for protection against frost, hail, or other extremes of weather.

The period of sowing beds will, of course, vary throughout the Colony, the object of the farmer being in each case to get his field planted out as soon after the departure of the spring frosts as is practicable, and also that he may receive the full advantage of the general rains of that season to give his crop a good start, with which view he sows his beds so long as three or four months in advance.

Without being dogmatic on this point, there is reason to think the period might be curtailed, (say) to eight or nine weeks. By the system of sheltered beds and stimulating liquid manures recommended, coupled with the practice of starting the seed before sowing, which may be done by mixing it in a canister or jar with the sand it is intended to be sown with, in a slightly moist condition, and keeping the vessel in a uniformly warm (not hot) position for about a week before sowing, a considerable saving of time is effected. It is not desirable to permit the seed to sprout in this condition, but only to soften the shell, and thus enable more speedy germination in the nursery. Tobacco seed, under the influence of a cold soil and climate, will not sprout—warmth, air, and moisture are necessary—so the farmer gains nothing by his long anterior winter or early spring preparation, when by waiting for more genial weather, and the practice of the process described, a large saving of time, with better and more certain results, may be expected.

Transplanting.

Before this work is proceeded with it will be necessary to decide which of the various forms of alignment practised in planting is to be adopted, and also the distance apart at which the plants are to be spaced. We have the choice of laying out the lines, squares, or quincunx, each of which has its merits, but with little reservation the last commends itself most to tobacco-growers, as it not only permits a greater number of plants per acre being set out, but also the option of three angles of cultivation, its drawback being the short turnings for horse and implement at the corners of the fields, which portions, however, may, at little inconvenience, be done with the hoe.

It is of the first economic importance in the work of further cultivation that where horse-power can be used manual labour should be dispensed with. Hence it is necessary that sufficient space between the rows should be allowed for this and the many other requisite operations in the future cultivation of the plant, such as spraying, *priming*, *topping*, and *suckering*. The area of space per plant to be allowed is also governed by the quality of the soil and the class of tobacco grown. In a rich soil the rows must necessarily be further apart than on a poor one. While a small-leaved Turkish plant thrives on 1 square foot of ground, a well-grown Connecticut requires from 12 to 14 square feet. The leaves of some sorts stand at an acute angle, and others at a right angle to the stem, each kind requiring a varying amount of space for its proper growth, so that it is impossible to fix an arbitrary distance.

With little exception, however, 3 ft. 6 in. between and in the rows, planted quincunx, will be found a liberal distance for even the most luxuriant growths. When ready to plant, the rows may be run out north and south, making true lines with a light one-horse plough, and by laying a properly-spaced knotted line tightly along the ridge so formed, the positions to be occupied by the plants will be ascertained by the knot-mark in the soil. This plan is also followed without the use of the plough-furrows, which are, however, to be generally commended. A cloudy or light drizzly day should be availed of for planting out, which will prevent excessive withering on the part of the newly-set seedlings; or in the absence of such weather this work would best be confined to the evening. The soil ought to be moist, but perfectly friable, and no present or future operation should be carried on in a tobacco-field when the ground is wet enough to cake.

Before removing the plants from the beds, these should receive a good watering an hour or so in advance to permit of their easy extraction without injury to the roots, which work may be variously done, as the uniformity in ripeness of the plants will permit or not. Where a cluster of ripe seedlings exist they may be lifted out in a body with a trowel or spade, but the larger number will have to be taken out singly, to do which they should be gently but firmly lifted out with the forefinger and thumb, seizing them either by the under side of the two largest leaves or by the stem near the roots; they should then be placed in a small basket, covered with a wet cloth. If the spatting of the seed-bed has been done as recommended at sowing-time, it will now be found that a small lump of moist soil will have adhered to the roots of each plant, which will prove of the greatest service in assisting its establishment in the field, which we will take for granted has received a proper preparation, and where, having been conveyed, the seedlings should be gently dropped one by one on the marks left by the spacing-line, and thereafter planted as speedily as possible, which should be done as follows:—Make a small hollow on the east side of the ridge, opposite the knot-mark, in the centre of which, with a round pointed stick, prepared for this purpose, make a hole large enough to easily receive the root, which, however, should not be buried too deep, nor in any way buckled or doubled up. The soil should then be gently but firmly pressed or worked round the plant, care being taken that no earth or other matter is lodged on the core or leaves. It should then, if necessary, receive a little water, delivered low for reasons already stated, and be protected from the sun or late frosts by shades of a suitable description, both of which attentions must be continued to the plant till it has thoroughly established itself in its new quarters which it will accomplish, according to the geniality or otherwise of the soil and climate, within a period varying from three to seven days at latest. By this time it will have become apparent what plants have failed to take root, when the vacancies ought immediately to be filled up with fresh seedlings. Shading the young plants is one of the necessary, but tedious operations which have made tobacco-growing more or less unpopular with Europeans in New South Wales. There are, however, no certain means of dispensing with this precaution, unless the farmer is favoured with a continuation of cloudy weather at planting time, which cannot be depended upon. The system of planting in hollows on the eastern side of the ridges recommended above, which shades them from the more powerful influence of the afternoon sun as compared with that of the morning, will, under certain conditions of the weather, prove sufficient; but it is inadvisable to entirely rely upon its protection, as a comparatively short exposure to a burning sun may undo the work of days or weeks. Saving those parts of the country where the banana grows, very little leaf shade is available, hence the habit of using dried or green rushes for this purpose, and with which no fault can be found, if care is taken that they are not made the medium for spreading mildew, which precaution is best effected by thoroughly sterilising them before use, by a few seconds' immersion in boiling water, or the application of any of the fungicides recommended in Dr. Cobb's article.

Worming and After-Cultivation.

When the young plant has fairly taken root in kindly ground it thrives well, and grows rapidly under the favouring influences of our spring showers and sun. But, that the greatest advantage may be derived from these, the labour of the grower is still necessary in the varied work of "worming," "keeping an open soil," "hilling," "priming," "topping," and "suckering," some of which operations proceed contemporaneously, and which will be described in detail. Under ordinary circumstances, when a tobacco-field has been planted out, the young seedlings become the object of immediate attack by a greater or lesser number and variety of insects, slugs, grubs, and all that tribe, most of which attack the plant above ground, while others, such as cut-worms (*agrotis*), confine their ravages to the underground stem and roots. All of these demand immediate removal before they have damaged, or, may be, utterly destroyed the plant, which they will speedily do if left undisturbed. But where either of the fungicides previously referred to has been applied as directed, it is anticipated that little damage will be done by insects at this period, as these mixtures will either make the vegetation it has been applied to extremely unpalatable or actively poisonous. These effects are, however, only temporary, and the farmer will later on have to contend with the important branch of tobacco-culture technically known as *worming*, which in the past, from its slow, irksome, and costly nature, exercised a prejudicial influence against the adoption by Europeans of tobacco as a crop for general cultivation. And from the not unnatural aversion manifested by them to this tedious form of labour, the industry has become, as a result, largely identified with the Chinese, which limitation however, with the removal of its conducing causes, will, it is hoped be dispelled. It can now be satisfactorily demonstrated that with the aid of a knapsack spraying-machine, and without posing or stooping in uncomfortable attitudes as formerly, one man can destroy more insects, &c., in three hours than ten men could do previously in the same period, and instead of the rigorous and repeated examination of the fields every third day or oftener, requisite under the old style of *worming*, a couple of sprayings at intervals of two or three weeks will prove amply sufficient to protect the crop from most forms of insect damage for the period of its growth. This fact should go some way in popularising its cultivation. This opportunity is taken of suggesting that a spraying-machine of some modern type appears to be as necessary a part of the equipment of the general farmer as his plough. Each man's holding should, and often does, consist of a combined garden, orchard, and farm, much of the various vegetation of which has scores of insect and other enemies that can do incalculable damage, and which can only be effectively and economically suppressed by such means as recommended. Hand labour of even the cheapest description is costly, and to a large extent ineffective in keeping down these pests where they abound, which is generally upon the richest soils and most succulent vegetation, entailing, proportionately, extensive loss which the prompt and judicious use of the spray-pump, with its various antidotes, can alone thoroughly prevent.

In the case of such a crop as tobacco, whose commercial value so largely depends upon the perfect condition of the leaves, it will be evident that a system which not only protects these, but does so at a tithe of the cost of time and labour formerly employed, should require no further recommendation; but when the same implement is of such general and varied utility on every farmer's homestead, the private or joint ownership of one should be considered a necessity. Its use will certainly reduce the cost of raising tobacco, as well as make the occupation more pleasant, and it is trusted that its general adoption for the purposes of this industry is merely a matter of time. Although other homely preparations, such as extract of gum-leaves, or an infusion of old tobacco-stalks and damaged leaves with carbonate of soda, may prove efficient, Paris Green is the insecticide to be chiefly commended for use on tobacco-plants, and the notes given in the article on "Insect and Fungus Diseases," page 328, give full particulars of its character, methods of application, and effect.

Cultivation.

In land of good natural texture and friability there is not much tendency to cake, and very little cultivation serves to keep it in good condition; but many soils, through poverty of organic matter, bad drainage, or excess of undissolved (integrate) clay, will cake after absorption of even a small quantity of surface moisture. This condition is bad for the growth of any crop, as the surface crust not only excludes the air, but, being a bad conductor, the heat also, so that the ground near the roots is chilled and growth restricted. Consequently where there is a liability to this formation it should be prevented by taking a one-horse cultivator or scarifier between the rows, and again transversely, as frequently as may be found necessary during the season. Grass and weeds should be rigorously kept down and a perfectly clean field maintained by the use of the horse hoe, as everything that detracts from the growth of the plant is detrimental to the quality of the leaf.

Care must be taken that neither the leaves or roots of the plants are damaged in this operation, which, apart from other favourable results, renders land and crops so treated less susceptible to the influence of prolonged droughts, as the unimpeded action of sun and air draws what moisture may exist in the ground towards the surface.

Hilling.

When the plants have attained a height of 12 inches to 15 inches, they should have the earth drawn or heaped round the stem to afford them the necessary support. This work, termed *hilling*, may be done by either a light single or double mould-board plough, or an implement similar to the latest fashion of maize cultivators, which can be gauged to various widths and carry two mould-boards on the after teeth, that heap the soil round the plant to the desired height. In the past this work was done by the hoe, but the above method will be found more economical, while equally efficient, if performed with care. In the case of very high-growing plants they may require to be hilled twice in the course of the season.

Short swingle-trees should be used to prevent injury to the leaves.

Priming and Topping.

The field life of the tobacco-plant in this Colony, with favourable weather, should range from ninety to not more than one hundred and ten days, the flower-buds commonly making their appearance from the seventh to the ninth week of this period. These, and two or more of the upper leaves, after attaining a certain development, should be nipped off, except in the case of those plants required for seed. This operation, styled topping, is generally conducted at the same time with the somewhat similar work of priming, or the removal of the ground-damaged and broken bottom leaves. Although some farmers, notably in France, where the crop is most carefully grown under the superintendence of the *Régie Nationale*, prime as early as the fourth or fifth week after setting out, so that the juices of the plant are not wasted on the nourishment of unmarketable leaves.

NOTE.—Where the leaf system of harvesting is adopted it may be permissible to allow the primary leaves to ripen and to harvest them the same as the others.

The object of both the above operations is to retain only such number of perfect leaves on each plant as it can thoroughly develop and mature. The sap that would have gone towards the growth of flowers and seed is thus diverted to the enrichment of those leaves which will form the crop, and upon the merits of which, individually, the farmer entirely depends for a reward for the labour and expense of their growth. When topping is performed *too high*, the upper leaves remain light and papery; thus, should a plant that can only properly mature twelve leaves be left with sixteen, there will not only be no gain in weight, but a distinct loss of quality will be apparent. Topping too low conduces to the development of thick midribs and veins, throws the leaves towards the ground, and largely changes the character of any variety so treated.

What a prominent agriculturist of this Colony termed the science of "common sense" is particularly requisite in this work, as no arbitrary opinion can be laid down as to the number of leaves to be left on each plant. So much depends upon the variety of tobacco grown, the strength of the soil, and the resultant condition of the plant. The number of leaves to be retained ranges, according to circumstances, from six to twenty-two, and must in each case be decided by the observation and experience of the farmer interested, guided by the object to be attained. This method is much more likely to be productive of correct results than the blind following of such dogmatic aphorisms as "prime high and top low," inculcated in some handbooks, and which, like many more wise saws, is only partly true and no guide of action. There is a concensus of opinion on the part of the most experienced tobacco planters and German chemists, who have carefully investigated the matter, that there is a decided loss of aroma in the leaves from the premature removal of the flower-buds that is not often recouped by the increased yield so obtained. It is therefore advisable, except in the case of late crops, to defer the operation of *topping* till the flower-buds have appeared with some regularity throughout the field, so that the work once entered upon may be performed without much interruption, and so tend to uniformity in ripening.

The cigar-tobacco of the North-East Coast should not be topped till the flower-buds are opening, when not more than two top leaves should be taken off with them.

It is clear that the system of harvesting ripe leaves only will permit of retaining a larger number to each stalk than where the practice of cutting down the whole plant is followed.

The pinching off of flower, stalks, and leaves is work for which children are well suited. It should be neatly and deftly performed, so that the wounds may not hinder the growth of the plant by dissipating its resources, or damage be caused to the remaining leaves, which will now rapidly expand and increase in body after receiving the above attentions.

Suckering.

Flower buds having, with the above exception, been remorselessly destroyed, nature immediately asserts its will by throwing out buds (suckers) at the axils of the leaves and stem, which if left to themselves will develop into leaves and flower stalks. These intruders must be constantly removed, and should never be allowed to grow beyond 2 inches in length. Their existence, of course, is at the expense of the vitality of the plant, which we are interested in making as perfect as possible. This work, known as *suckering*, becomes almost continuous for the remaining period of the field-life of the plant. This will vary from two to four weeks, according to the merits of soil and climate, which in some measure determine the number of growths of suckers that will be thrown out. This number will vary, and will be greater in the more stimulating climate of the northern seaboard than elsewhere; but in every case a careful examination and trimming of the plants will be necessary every three or four days. In the earlier work of tobacco-growing, intervals of varying length will occur during which the every-day presence of the labourer among his plants may not be necessary. From the appearance of the first sucker, however, till the crop has been placed in the curing-shed, his attention will be fully occupied in doing justice to his 3-acre charge, either indoors or out. It will greatly conduce to the perfection of the crop if the field operations just described are carried out after the dew has left the plants, when they have become tougher and less liable to injury.

Second Crop.

In the northern half of the Colony, if the harvest is moderately early, a second or "ratoon" crop, not inferior to the first, may in many districts be legitimately expected, the strongest one of the many suckers starting from the underground stem alone being left to grow. Where such conditions exist, the same assiduity and attention to the details of cultivation as previously advised will be necessary.

Seed Plants.

Plants reserved for seed should be of the strongest in the field, and distinguishable by being attached to a tall rod, firmly fixed in the ground. This will also serve to support them against strong winds. They should receive the same care in suckering as the other plants, and, as insecticides may not be used on them with safety, worming should be done by hand. When the seed-pods have ripened, which may be known by their turning a dark-brown colour, they may be harvested either by cutting off the seed-heads and hanging them head down in a dry place, or, where field insects attack the pods, which they frequently do, the whole plant may be pulled up by the root, even before perfect maturity, and allowed to ripen in a like inverted position in the curing-house.

In shelling the seed, all undeveloped pods should be rejected.

Ripening.

Within the period stated, signs of advancing ripeness will be observed throughout the field, and are not difficult of discernment by anyone even slightly acquainted with the crop. The luxuriant green of the plants gives place to a marbled or mottled pale green and yellow colour; the veins appear swollen, and the leaves heavy and fleshy, with a gummy feel, while the tips, when doubled forward, break with a clean fracture.

Harvesting.

A moderately bright but cool day after the dew has left the plants is best for harvesting tobacco, but the possession of a good field shelter, such as previously recommended, will render the farmer comparatively independent of the ardour of the sun. In its absence he will have to be careful.

Armed with a suitable knife, gently turn up the bottom leaves of the plant, from which it is assumed all suckers, decayed leaves, and insects have been removed, and after bending it to one side, with a sharp blow cut close to the ground, on which lay it carefully down with its butt inclined towards the sun, where, in ordinary course, if the latter is not too strong, it should remain until thoroughly wilted. It will then have acquired a toughness and pliancy that will enable it to be transported by cart or otherwise to the curing-shed without injury if ordinary care is exercised, which it is very necessary should now and at all times be practised. In the soft and tender condition the plant has assumed the tissues of the leaf are easily bruised, permanently injuring the affected part, and reducing the most perfect leaf to the low commercial and priced grade of "broken" tobacco.

At the risk of repetition, we again desire to point out and impress upon the reader that seven-eighths of the defects found in New South Wales tobacco in the past have been not only the result of imperfect knowledge in its cultivation and curing but of a more or less deliberate carelessness in the treatment and handling of the plant from this cutting stage onwards. And we would urge that if the very desirable improvement in appearance and quality which is possible in this commodity is to be effected, greater care and intelligence will have to be exhibited in its preparation than has yet been done, save in one or two instances.

Curing.

This will bring the grower up to the period of curing. The curing of the leaf is of such importance that it is not possible to spare in a handbook of this kind the space that is necessary to illustrate the methods of erecting drying sheds and explaining the various processes of manipulation. The Department of Agriculture has already published a comprehensive work on these matters, and persons wishing to go fully into the subject can, on applying, obtain a copy *gratis*.

HOPS (*Humulus lupulus*, Linn.)

JOHN COLEMAN.

Climate.

THE climate should be temperate and free from hot winds in summer. In winter frosts are very beneficial to the health of the plants, particularly in stopping during that period the growth of young shoots, thereby throwing the vitality into the bines and fruit during their proper season.

Situation and Soil.

Districts like Armidale, Cooma, Goulburn, and Orange are well-adapted for the growth of hops. There is no crop which suffers more from winds than hops, and, therefore, in choosing land, care should be taken to secure a site with an easterly or north-easterly aspect, well sheltered from south and south-westerly winds by either natural timber or artificial shelter.

The soil should be a deep rich loam, rather stiff in texture, and of a clayey nature. If a large crop is wanted a good alluvial soil is suitable for strong growing varieties.

Preparing the Soil.

Plough with a good deep furrow, say 8 inches; take off the mould-board of another plough and subsoil the land at bottom of furrow by breaking up the under surface 6 or 7 inches without bringing the soil to the top. This is done by running the second plough after the first one in the same furrow. If you have a subsoil plough, of course that would be more suitable. This should be continued until the whole paddock is ploughed. Then take the harrows and cross-work the land well to make a level surface, and also a deep, fine bed ready for planting the hop-sets.

Under-draining.

This is of the utmost importance in keeping the hops in a healthy state, as in a wet subsoil they are very subject to mould. There is no fertiliser that can be used which will give quality to the hops equal to under-draining. Common agricultural drain-pipes of 3 inches diameter are found by experience to be the best size for airing the land and causing the soil to work more freely. Their cost is about the same as that of bricks, and they can be made by any brickmaker. Four feet in depth, and about 40 feet apart, is found to drain ordinary soils well. Stiff, heavy, clay soils require the drains more shallow and closer together; sixty-four drain-pipes are required per chain, so that the quantity required can be easily ascertained.

In regard to the necessity for under-draining, the following facts speak for themselves:—

The disease called "red spider or fire-blast" usually makes its appearance after a few years cultivation on low-lying, rich, alluvial land, if irrigated; also on highly-manured, wet, retentive soils, unless well under-drained.

Be careful not to allow sheep to feed off the autumn shoots which grow from the hop-hills, after the hops are picked, as it causes the crown of the hills to dry—rot and decay, particularly on badly-drained, wet land.

Varieties of Hops.

In the period of ripening early sorts will be ready for picking about six weeks in advance of the late varieties.

Early Sorts.—White's Beltering Golden, Early Prolific, Henham Jones', and Jones'.

Medium.—Grape, Cluster, Fuggle's Goldings, Golden Tips, Pure East Kent Goldings, and Meopham Goldings.

Late.—Colegates, Late Goldings, White Bine Colegates, and Mole's Late Goldings.

There are several other varieties similar in character to those I have mentioned. The hops known in the trade as Americans are Grape and Cluster.

The Californians grow Cluster and a hop very like Fuggle's Goldings. The Germans principally grow pure Goldings, of first-rate quality, by a special process, but they never grow heavy crops.

The hops used by the brewers for the best pale ale are mostly pure Goldings and Jones', these possessing a very delicate bitter, and a nice light colour, with plenty of lupuline. Other varieties are used for stock ale and for porter brewing. Colegates are sought after since they contain most lupuline or brew, but of a rather strong flavour.

Raising the Plants.

Hops are usually raised from cuttings or sets, as they are called, which are taken from the hop-hills in winter or early spring before growth has commenced. They are cut about 6 inches in length, but it is necessary to have at least two sets of eyes on every set, as the bottom set of eyes will form roots and the top ones bines or shoots, which produce the hops. Choose a nice clean plot of ground and plant your sets in rows, with top of set just showing on the surface. The rows should be about 18 inches apart with a space of 6 or 7 inches from set to set. Keep them clear of weeds during the summer, and the following winter dig up the sets and plant them in their final quarters. With hops, as with grapes, by adopting this method one year is saved in their production of fruit. This is the usual practice in all hop-growing districts.

They may also be raised from seeds, but it is a tedious process, taking four years to show the true character of the fruit. Moreover, plants raised from seed are liable to sport, as the hop-plant is a "wind hybridiser," so that several sorts may come from the seeds of the same hop.

Planting.

Obtain a supply of small sticks, about as thick as the little finger and a foot long. Get the square of your paddock north, south, east, and west, and take two lines to cross each other as near the centre of the paddock as possible, one north and south, the other east and west, and put out the rows due north and south, 10 links apart and 10 links from hill to hill. If these instructions are carefully followed the hills will come in perfectly straight lines every way. This distance apart gives 1,000 hills per acre, which from long experience is found to be the best for horse labour, and also to enable the plants to get the full benefit of the sun's rays and free circulation of air.

Have the sticks abovementioned placed in position. Take a spade and cut out a square hole around the stick thus ⊡ about 18 inches at the surface and 12 inches deep, stirring up the subsoil at the bottom of the hole to enable the roots to go down, and place the stick in the hole for future use. Then take three strong sets (four if weakly), cut off the roots to 5 or 6 inches in length; place a small mound of fine earth in centre of hole, place your sets at even distances around, bringing their tops together, and about even with the surface of the soil, filling in the hole with fine earth over the roots, and gently treading in till the hole is filled to the surface; then place the sticks over the sets to mark the position of hill. A little well-rotted farmyard manure mixed with the soil when filling up the holes will give the young plants a start, and enable them to withstand dry weather better during their first summer's growth.

Cultivation.

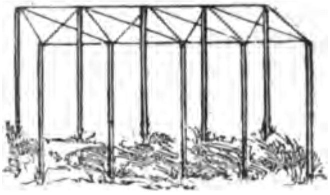
As soon as weeds appear work the land across between the hills with a Planet junr., taking care not to stir the soil too close to the sets. Use a hoe around the hills to cut out the weeds. This is the only cultivation needed during the first summer. A little after midsummer go over the plantation, hill by hill, and collect the vines that are found trailing over the ground; give them a twist round and tie in a loose knot on top of the hill, in order to put them out of the way of the horse-hoe, which should be used frequently to prevent the growth of weeds, which is of the utmost importance.

As a rule, hops are not cultivated for a crop the first season, as the expense of finding small sticks or poles which are not large enough for use in the second and following years is very often more than the crop is worth. Moreover, by not allowing them to fruit the first year, the stock becomes much stronger and capable of producing heavier crops in after years.

We have now arrived at the autumn of the first year with our plantation of hops free from weeds and the land in good order. The next process is to take a light one or two horse plough and turn up a furrow to the hills of hops (not too close to injure the young roots) from end to end of the plantation, ploughing four furrows along each alley or space between the hop-hills, turning two furrows to the right and two to the left hand. The object of this is to leave a surface-drain in the centre of the alley to take away the surface water during winter, as hops are likely to become affected by "mould" if water is allowed to accumulate on the land in winter.

Stringing.

The system of growing hops on poles was largely in favour some years ago, but what is known as the string-system is now more generally adopted, particularly where poles are difficult to obtain. When poles are used, three poles are required to each hill; and as there are 1,000 hills to the acre, it follows that 3,000 poles would be required for the same area, and in a field of only 10 acres 30,000 poles would be needed. This is a serious item where it is difficult to obtain suitable saplings. I say suitable, because the thicker the poles the greater the labour involved, besides being more inconvenient in every respect.



The string-system only requires one stake or pole to each hill, which should be about 9 or 10 feet long, and of the same thickness as an ordinary vineyard stake; and it should be inserted 12 or 15 inches into the ground, and distant from centre of hill about 9 inches on the western side. The stakes may be placed in position in winter, as they are never taken up when once erected. The strings (best seaming twine) are run along the tops of the stakes and then crosswise from pole to pole; forming a network over the entire hop-garden. A very simple arrangement is used for the tying on of the string; a rod of about 9 or 10 feet long, with a hook or ring in the top for the string to pass through, is used. A common skein-winder is strapped in front of the operator by a strap passing round his waist; the end of the string from the winder is passed through the hook or ring at top of rod, and tied to the top of the first pole. The operator, keeping the string tight in his hand, passes on from stake to stake, giving the string one entire turn around the top of each one, being careful to keep the string at a good tension. When the end of a line of hills is reached he passes on to next row, and repeats the operation until the network is completed. The stronger the variety the greater the number of directions to be provided in which to train the vines.

Dressing Hops.

The process of dressing the hops is performed in early spring, before the bine starts into growth. With a narrow short-handled hoe open and remove all the earth on the top and around the hill, find all the suckers running out from stock, then cut the sets, suckers, and loose roots as close as possible to crown of hill with a sharp knife, and replace sufficient fine earth to neatly cover the exposed stocks, leaving the ground level instead of in a mound, as formerly. If sets are required for new plantations, they must be saved, as previously directed.

Tying.

As soon as the bines have grown to the length of about 2½ to 3 feet, choose six of the best *fruitful* bines as near the centre of hill as possible; give them a twist round the stake, turning them from east to south to west, (they will not grow trained in the other direction), taking care they do not cross each other. Tie to the stake with soft rushes in a slip-knot, so as not to strangle the bines when they become thicker. These rushes are found growing in swampy places. The hop-tying season lasts about seven to eight weeks, and the plants require looking over at least four times during that period. This work is usually done by women and children, who, when accustomed to it, earn good wages.

During the summer, when the hops are growing, the hills must be kept free from weeds by the use of a good fork or common hoe; all superfluous bines should be pulled out, branches cut off from crown of hill, and all weeds pulled out where the hoe cannot be used. When the hops are grown nearly full size, and there is a good depth of fine earth in the alleys which has been cultivated by horse labour, place five or six large shovelfuls of fine earth on top of the crown of each hill:

1st. For the purpose of inducing roots or fibres to shoot from the butts of the bines, to help sustain the fruit.

2nd. To keep the hills moist, and to protect them from the scorching sun's rays, and to keep out the wet from the crown of hill in winter.

3rd. To provide sets for planting other plantations (the earth being placed on the hills causes the butts of the bines to thicken and form sets), as this is the only way that the hop can be propagated. After this process, or "ringing in," as the growers term it, put a horse-hoe over the land a time or two, then with a strike-furrow plough of wide spread strike a furrow from end to end of hop-garden, to provide water-channels in case of heavy rain.

Picking.

According to the kind of hops and the different beers to be brewed, so there are different stages of ripeness for the picking. The following is the general method of making the test:—Take a hop-flower or two from an outside bunch of hops, strip the leaves or bracts from the stem of the hop-flower, and if the insides of them contain plenty of "Lupuline," or golden-yellow dust powder, and the seeds are ripe, which can be readily determined by cracking them, the hops are ready for picking. A little knowledge gained by actual experience is, however, required before a person is an expert judge. Hop-picking is generally done by women and children; but I must here explain that the hop-plants grown on poles are cut off about 12 or 15 inches from the ground, and the poles, with the crops twined round them, are removed from the ground, and placed in position for the women and children to do the picking. When the plants are grown on the string system the men cut the strings down from the top of the stakes ready for the operations of the women and children. The men are further employed shifting the bins or baskets, and in carrying to the waggon the freshly-picked or green hops when bagged, also in stripping the bines from the poles when the hops are picked off. The hops as picked fall into bins or baskets—any leaves or twigs are removed, and the baskets are taken to the hop-kiln to be dried and baled for market. It is desirable to empty the bags as soon as possible on to the hop-kiln, as the green hops ferment very quickly if kept enclosed in bags, which causes the hops to turn a dirty red colour, and the appearance of the sample is entirely spoiled.

Drying.

The process of drying is carried out in a circular kiln (after the style of a malt-kiln), on a floor covered with hair-cloth, and distant above the fire from 14 to 16 feet. The hops are dried with smokeless coal or charcoal for about ten hours, until all sap and moisture are expelled. After being put on the hair-cloth and warmed through by the action of the fire, a few sticks of sulphur are burnt on the fire, and the fumes, passing up through the hops, destroy all insect life, improve their colour, and cause them to retain their quality for a much longer period. They may be placed on the hair-cloth from 12 to 16 inches deep, according to the degree of ripeness when picked. Hops dried by good charcoal make the best samples, feeling softer to the touch, with a less strong smell of the fire. They have also a brighter appearance in the sample, and are, according to the brewers, more delicate in flavour.

After having been dried sufficiently they are taken from the kiln into a large room and usually passed through a large mesh sieve, to take out small bunches of underdone hops, and to thoroughly mix them to make a more uniform sample. After being left in the room to get sufficiently cool they are packed in bales or pockets, made of stout jute cloth, weighing about 24 ounces per yard, of which it takes 5 yards, doubled in half and sewn up the sides with good seaming-twine, to make a pocket. A large handful of hops is tied round in each of the bottom corners to form lugs to carry the pocket by. The hoop is then sewn in the top of the pocket, and the empty pocket put in the hop-press. A few hops at a time are placed in the pocket and tightly pressed up until it is full. The hoop is then taken off, and the top of the pocket neatly sewn up, leaving lugs at each corner. The pocket of hops is then ready for market.

In baling up hops the process is much the same, only that the jute cloth of the required size to fit inside the bale-press is sewn square, and the filling goes on as in the former case.

It is the custom to mark on the outside of the bale or pocket of hops the name of the grower and the parish and county where grown, in letters of 4 in. in length and ¾ in. in width. This is compulsory in England under the Trade Marks Act.

A pocket of hops weighs from 1¾ to 2 cwt., and a bale of hops from 2½ to 4 cwt.

Commercial Aspect.

Before closing this article we must look at the commercial side of hop-growing. There is no other agricultural industry which presents such variations, both in regard to yield per acre and market value of the produce. In what may be termed blighty years the yield in England is only 1 to 2 or 3 cwt. per acre, and, on rare occasions, none whatever; while in a favourable cropping season as much as 30 cwt. per acre, and even more, has been picked. An average crop from well manured and cultivated land might be set down at from 12 up to 15 cwt. per acre. In years of over-production hops may be sold for 30s. per cwt., and the next season, or the one following that, may realise as much as £25 to £30 per cwt. Colonial hops average from 11d. to 1s. 3d. per lb.

FLAX.

FLAX has been tried in various parts of the Colony, and in the cooler parts grows well.

The most suitable soil is a deep, free loam, with a clay subsoil. It is important that the land should be thoroughly cultivated by ploughing, cross-ploughing, and harrowing, in order to bring it to the finest possible tilth.

For fibre, from 2 to 3 bushels per acre should be sown; but for linseed, half a bushel of seed is sufficient. In the coastal districts June is the best time to sow, but on the tablelands sowing should be deferred till August. After sowing, the seed should be covered with light closely-toothed harrows.

Under ordinary circumstances the crop will be ready for harvesting in from four to four and a half months.

These notes are from an article on Flax Culture, by F. Turner, *Agricultural Gazette*, vol. II, p. 85.

HEMP (*Cannabis sativa*).

G. VALDER.

WITH the purpose of testing whether hemp is a suitable crop for this Colony, and as to what parts were most favourable for its cultivation, the Department imported a quantity of hemp seed from Messrs. Sutton and Sons, the well-known English seedsmen. This seed was distributed in August and September, 1892, to about 600 farmers in all parts of the Colony, and from reports furnished by them, and from the cultivation by myself of several small plots in the Sydney district, the following information has been gathered:—

Lands having an altitude of less than 2,000 feet gave the best results.

Chocolate loam was found to be by far the most suitable soil for this crop, although several very good returns were obtained from the lighter loams; but on sandy soils and clays the crops were, in nearly every case, a failure.

The lower portions of the Northern and Southern Tablelands, having an altitude of from 1,000 to 2,000 feet, and the chocolate loams of the Northern Rivers district, gave the best returns, both as to yield of seed and fibre. In several parts of New England the crops grew very strongly during the spring, but the dry summer completely destroyed them.

Sowing took place from the end of August until the commencement of October. In the warmer districts the early sowings gave the best returns, but in the colder districts many of the crops were sown too early, and, as a consequence, they were destroyed by late frosts. Mr. C. Fraser, of Mittagong, reported that his plants were badly injured by frosts on the 14th and 15th December. Mr. F. E. Thomas, of Numeralla, near Cooma, reports that he considers that in no case should hemp be sown before October in his district.

Germination took place in from five to fourteen days from the time of sowing. The seed supplied was evidently very good, as the average number of plants obtained was no less than 66 per cent.

The land was either ploughed and harrowed or deeply dug. In many cases a portion of the seed was sown broadcast and the remainder in drills. If anything, that sown in drills grew the stronger, but there was little difference either way. Only in a few instances was manure applied. Farmyard, cow, and fowl manure, and wood ashes were tried, but the result was very doubtful.

The most remarkable feature in these experiments was the very slow growth of the plants, the average being about 6 inches per month. In no case were the plants reported to have grown more than 3 feet 6 inches high, and in several instances the plants flowered and produced seed when only 15 to 18 inches high. At Croydon I made two sowings—one in a paddock which had been ploughed and harrowed ready for a crop of sorghum, and the other in the vegetable garden, where the soil was fairly rich and well worked. Although the plants grew well at first in both places, those in the paddock were only 2 feet high when they matured, whereas the plants in the garden were from 3 feet 6 inches to 4 feet in height, but none of them exceeded this.

Several samples of seed, including two of my own, were brought to the Department, and, on comparing them with imported samples, it was found that the colonial-grown samples were equal to the imported, one sample being superior. The seed was large, even, and of a pale bright colour.

From what I can gather from these reports, and from my own experience, I believe that there are many parts of this Colony where a good yield of seed of first-class quality can be produced. With regard to the fibre, I also think that our rich loams on the coastal districts, and also several portions on the Northern and Southern Tablelands, are very suitable for its production, provided that a more thorough system of cultivation is adopted than is usually given to the crops grown there. Fibre of a first-class quality certainly cannot be produced without the following conditions:—

1. A rich loamy soil, or a fairly rich one with manure.
2. A good rainfall. (In all the drier districts in which this crop was tried the plants were very stunted.)
3. Good cultivation. Unless the soil is thoroughly worked and pulverised the plants will not grow strongly.

SUN-FLOWER.

THERE are very few districts in which the sun-flower cannot be easily grown. The yield of seed is very heavy, and it is a splendid feed for poultry.

The seed may be sown in drills, 3 feet apart, and the strongest plants only be allowed to stand for growth (say) about 18 inches in the rows.

No special culture is required, except that the crop be kept clean—that it be not exhausted by weeds. If a little "hilling" or earthing up be given when the crop is 2 or 3 feet high, so much the better.

The variety yielding the largest quantity of oil per bushel is the large black; but as the smaller striped Russian is a much more prolific cropper, it is considered the more profitable one to grow. The returns from crops of this variety during the past season, cultivated as above, were on an average £15 per acre, the seed or grain being sold for poultry food, and not for oil extraction, in which respect there is no sale at present.

Seeds may be obtained from any seedsman, and be sown when the frosts are done.

BUCKWHEAT.

THIS is another good poultry feed. It does not require a particularly rich soil or special cultivation. It can be sown either as a spring or autumn crop. About 1 bushel of seed per acre is required for broadcasting.

MISCELLANEOUS SUB-TROPICAL CROPS.

*G. M. McKEOWN.

ARROWROOT (*Canna edulis*).

THIS crop may be successfully grown in most of the moist coast districts.

The soil should be light, rich and well drained, and should be deeply broken and thoroughly worked before planting. September is the best month for planting, but in a moist spring it may be done earlier.

The plants are propagated by division of the stools, and care should be taken that the bulbs chosen for planting are furnished with "eyes," to form the new growth.

The bulbs should be set out in furrows 4 feet apart, the plants being 3 feet apart in the rows. The furrows should be opened about 6 inches deep.

For some time after planting cultivation may be carried out by means of Planet Jr. implements, but very little attention will be required after the ground becomes shaded by the plants, as if well tilled during the early growth of the crop the soil will remain open and free from weeds.

In about ten months the crop will reach maturity, and may then be prepared for market, or profitably used as food for stock or poultry.

As a mill for the manufacture of arrowroot is in course of erection on the Richmond River, it is probable that owing to the cheaper means of preparing the product the value of the crops in its neighbourhood will be increased.

THE BANANA (*Musa sapientum*).

FROM the Clarence River northward, in suitable soil and situations, the banana may be profitably grown provided proper care is bestowed on the plantation.

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* Late Manager, Departmental Farm, Richmond River.

The best situation is an easterly or north-easterly slope, well sheltered from winds, especially those blowing from the west. A locality not liable to severe frosts should also be chosen.

The best soil is a deep free loam rich is vegetable matter, and well drained

The land should be thoroughly broken at least a foot deep, the holes for the plants being opened to that depth, and the soil at the bottom being well broken. Care should be taken to remove all roots or decaying wood from the neighbourhood of the holes, as sometimes a fungus disease is conveyed to the plants by them. September is the best month for planting, but suckers may be safely planted at any time. The suckers should be planted about 20 feet apart.

Owing to the presence of gall worms in many of the plantations in the northern districts the strictest care is necessary in procuring plants to see that they are free from this pest, which has destroyed a number of flourishing plantations. The presence of the worms may readily be detected on examination of the roots, which in diseased plants exhibit a number of excrescences encasing the worms. On no account should plants be taken from a plantation in which they have appeared.

In order to produce fruit of the best quality it is essential than the number of suckers growing from each plant be limited, not more than three or four being permitted to grow at one time, and being so arranged as to produce fruit in succession.

It will be found advantageous to restore all refuse leaves and the stems of suckers which have been cut off, to the ground for the nourishment of the plants, and, where practicable, to supply vegetable matter from other sources.

From a well-cared-for plantation, under favourable conditions, a return may be expected within 18 months from time of planting.

A limited local market is available, but the Sydney market will afford the best means of disposing of the fruit, which should be cut before it is ripe. The bunches may be packed in crates, or sent open as is the practice with shipments from Fiji.

CANAIGRÉ (*Rumex hymenosephalus*).

As it is probable that in the low rich lands of many of the northern rivers this newly introduced tan plant may be profitably grown, it is worthy of trial to a limited extent pending the establishment of a local market for it.

The time for planting is in the autumn.

The soil should be deep, rich, and moist, and should be well broken by subsoiling to admit of the free growth of the roots. The roots should be divided, care being taken that each has an "eye" to form the new plant.

The crop may be harvested when quite matured, the signs of which are the dying of the leaves.

Trials conducted at the Hawkesbury Agricultural College and at the Wagga Experiment Farm have proved that this crop is suited to the Colony, and further trials are now being conducted as to the yield per acre and quality of the tubers.

Cultivate in the same manner as potatoes, except that they can be grown a little closer. March has proved to be the best time for sowing at Wagga.

COFFEE (*Coffea arabica*).

FROM the Clarence River northwards coffee has been produced to a limited extent with a fair amount of success.

The best site for a plantation is a warm north-eastern slope, having a well-drained soil rich in vegetable matter. A locality free from severe frost and sheltered from winds is absolutely necessary.

Where not rendered open by small stones, the soil should be broken deeply.

The best time for forming a nursery to supply young trees for a plantation is from November to February, as it is essential to plant seeds fresh from the berries.

The seeds should be sown in a well-prepared bed under shade, the "beans" being placed about 2 inches under the soil, flat side downwards, and about 6 inches apart. The bed should be kept moist at all times.

In about twelve months the seedlings will be ready to transplant; but it will be found advisable to harden them by gradually removing the shade.

Showery weather, with a prospect of continuance, should be chosen for transplanting, and, when necessary, the newly planted trees should be shaded and watered.

The plants should be placed 8 or 10 feet apart, in rows. In taking up young trees for transplantation, care should be taken not to injure the tap-root, which should be placed in the hole in its natural position, the bottom of the hole being well broken up to allow it to penetrate the soil.

In stony land, where horse cultivators cannot be used, the best implement will be found a three or four tined hoe of wrought iron, absolute freedom from weeds being necessary for the success of the trees.

All suckers should be removed, and the trees "topped" at the height of about 5 feet, all useless branches which have ceased to bear being cut out to admit light and air.

GINGER (*Zingiber officinale*).

IT is improbable that ginger can be produced as a paying crop south of the Clarence River.

The most suitable soil for its growth is a light loam, rich in vegetable matter and possessing good natural drainage. The best month for planting is September.

The land should be deeply and thoroughly worked, and formed into ridges 3 feet apart, the rhizomes being planted in the ridges 12 inches apart and about 3 inches under the surface.

Where obtainable, a liberal supply of well rotted stable manure should be worked into the soil, as the crop requires plenty of nourishment.

The crop will mature in about ten months, and should be harvested after the tops have died off.

Harvesting should be carried out in a similar manner to that practised with potatoes, &c., especial care being taken not to injure the "hands" or rhizomes.

To prepare the produce for market, the "hands" should be placed in boiling water for about five minutes and then dried in the sun.

The colour of the ginger may be improved by scraping and by fumigation with sulphur.

THE PINEAPPLE (*Ananassa sativa*).

ON high land free from frosts this fruit may be successfully grown on a commercial scale in the north-eastern districts.

The most suitable soil is a sandy loam, well drained naturally, but excellent results have been obtained in the volcanic soils of the Richmond and Tweed.

The land should be deeply worked to prepare for the plants, which should be placed in rows 6 feet apart and 3 feet apart in the rows. Spring and early autumn will be found the best seasons for transplanting.

Plants may be increased from the leafy crowns of the fruit or from the suckers which spring from the plants, the latter giving an earlier return than the former. They should be prepared for planting by the removal of a few of the lower leaves in order to allow the roots to start. From plants raised from suckers a return may be obtained within two years from planting.

The best implements for cultivating between the rows are the Planet Junior horse-hoe while the plants are young, and as they increase in size the Planet hand plough will be found a most economical implement.

For planting on a large scale it is recommended that the suckers should be set out in rows 8 feet apart and 4 feet in the rows. The work of cultivation can then be done almost entirely by horse labour, and when making a new plantation the spaces between the rows can be filled with new plants, the old ones being removed when it becomes necessary to replant.

The suckers which form after the production of the first fruit should be thinned out, otherwise the quality of the fruit will deteriorate.

For transport to the Sydney market, the fruit should be cut when about to change colour, the pines being carefully packed in cases about 3 feet x 18 inches, so constructed as to admit plenty of air.

PEA-NUTS (*Arachis hypogea*).

IN most of the north coast districts these may be successfully grown at comparatively small cost.

The soil should be of a free nature, not liable to bake on the surface. It should be thoroughly pulverised, but should be broken more than 4 inches deep, as deep working renders harvesting much more difficult, it being desirable to keep the nuts as near the surface as possible, otherwise many will be left behind in digging.

The seed should be sown in September in drills 3 feet apart, the nuts being placed from 9 to 12 inches apart in the drills and about 3 inches from the surface.

The nuts may be planted whole or the kernels may be removed and sown singly, by the latter method a saving of seed being effected.

The quantity of whole nuts required to sow an acre is 40 ℔. The soil should be kept open and free from weeds till the vines have covered the ground, when the crop will not require much attention till harvest time.

The crop should be harvested when the vines begin to turn yellow, and while most of the nuts will adhere to the roots.

The vines may either be ploughed or dug out and left to dry for a few days when the nuts may be gathered.

As a number of nuts will be left in the ground, pigs or poultry will be found useful in clearing up the remnants, and both will be found to thrive on them.

RAMIE (*Bœhmeria nivea*).

ALTHOUGH not yet proved a commercial success, this fibre plant is worthy of attention on the part of farmers as under experimental cultivation it has thriven well on high land.

As it requires plenty of moisture, however, far more favourable resutls should be obtained on the rich river flats of the north coast, which possess a more retentive soil. The land should be deeply worked and formed into wide ridges 3 feet apart at the top. Furrows should be opened on the top of the ridges, and the plants placed 18 inches apart in the drills and covered with about 3 inches of soil.

Propagation is carried out by means of division of the roots, any portion with a bud forming a new plant. Plants may also be raised from seed or from cuttings, which will "strike" readily in moist weather or if kept watered. The canes should be cut for stripping while the sap is circulating freely, but machinery will be required to prepare the product for shipment.

Trial parcels have been sent to London to test its quality and value, and Mr. Jackson is now conducting at the Richmond River Farm experiments to determine the practicability of producing the ribbons on a commercial basis. He has already obtained a machine for treating the raw material, and his reports on the results will appear from time to time in the *Agricultural Gazette.*

Pending this test, it would be well for farmers to plant a small area in view of possible favourable developments.

RICE (*Oryza sativa*).

ON the rich, moist soils of the lowlying lands of the northern rivers, the cultivation of rice is worthy of extended experiments, but the red volcanic soil of the high lands has so far failed to produce satisfactory results owing to the rapid escape of moisture through the subsoil. The soil necessary for its growth without irrigation is a sandy loam with a clay bottom, having power to retain moisture sufficiently long to prevent the growth of the crop from being checked by dry weather. As no experiments in irrigation have been made, reference is made only to "dry" cultivation.

As Messrs. Harper & Co. have reported that only the short plump grain of the Japan variety is marketable in the Colony, that only should be grown at present with a view of testing the market.

October has so far proved the best month for sowing. The land should be deeply ploughed and harrowed until it is brought into the finest possible condition for the reception of the seed which, after having been soaked for forty-eight hours should be sown in drills about 15 inches apart, or broadcast. The drill system will be found the best, as affording facilities for tillage, and checking the growth of weeds. About three-quarters of a bushel of seed will sow an acre in drills.

The grain should be harvested by stripping, as if the straw is reaped, much of the seed will be shaken off in the operation.

SUGAR-CANE (*Saccharum officinarum*).

THE only portion of the Colony suitable for the successful growth of cane is the coast district extending from the Clarence River northward.

The increased severity of recent winters has demonstrated the necessity of confining its culture to situations in which the cane will not suffer from frost.

For this reason well-drained hill-sides and high lands should be chosen as sites for plantations.

In land free from stones the soil should be thoroughly broken by means of subsoiling to a depth of a foot or more, the surface soil being turned over by ploughing in the ordinary way, the subsoil being broken and retained in its natural position by following in the same furrow with a subsoil plough.

Where a proper subsoil plough is not available a simple substitute may be made by removing the mould-board from a plough of ordinary construction.

Some of the heaviest crops of cane produced in the Richmond River district have been grown in stony land where manual labour only would be possible, the increased yield amply compensating for the greater cost of production.

The best months for planting are September, October, and November.

The "sets" or plants should be procured from perfectly healthy and vigorous canes, the upper portions of the canes being the best for the purpose, although the whole of the cane may be used. Each set should have from two to four sound eyes, and should be planted from 9 inches to 1 foot deep, about 3 inches of soil being placed over them, the drills being filled to surface level after the plants have made some growth. The drills should be 6 feet apart, and the plants 6 feet apart in the drills. The system of wide planting favours the production of more vigorous cane, and renders the work of trashing and tillage much easier than is the case where close planting is carried out.

The best implement for tillage during the growth of the crop is the Planet, Jun. horse-hoe fitted for scarifying with narrow tines. All weeds should be destroyed in the earliest stages of their growth, for this purpose a horse-hoe with a set of "sweep" fittings being the most effective.

The subject of cane diseases has been fully dealt with by Dr. Cobb in *Agricultural Gazette*, vol. iv., page 777.

Before entering upon cane-growing it will be necessary for new planters to contract with one of the sugar mill proprietors carrying on operations on the northern rivers, otherwise they may be unable to find a market for their cane.

Fruit Culture.*

By ALBERT H. BENSON, M.R.A.C.,
Fruit Expert.

In the various articles on fruit-growing that I have prepared for the *Agricultural Gazette* I have always supposed that my readers possessed, at any rate, a slight knowledge of the principles of fruit-culture. Notwithstanding this, however, I have endeavoured to write in as practical and simple a manner as possible, so that no one possessing the slightest knowledge of the business would have any difficulty in understanding and carrying out the instructions given. Now, I am writing for those who have no knowledge whatever of the rudiments of fruit-culture or of the cultivation of the soil, and will therefore endeavour to express myself in a still more simple and explicit manner.

I am writing especially for those who have been brought up in cities—men who are unable to obtain suitable employment on account of the congested state of the labour market, but who, had they the knowledge and means to apply it, would be able to make a good living from the soil, provided that they are able and willing to work.

It is no use for anyone to think that he will make a success of fruit-culture without working, because there is no branch of agronomy (which means the science and practice of agriculture in all its branches) that requires more steady perseverance, hard work, and careful attention to detail. The successful fruit-grower never considers any necessary work insignificant, and he never puts off till to-morrow what he can possibly do to-day. I therefore strongly advise no one to go in for fruit-culture unless he is prepared to put his heart into the work and to perform it thoroughly. In this case fruit-culture will be found to be a very paying business; but if carried out in the careless manner that is so often seen, it is sure to end in failure sooner or later.

Choice of Locality.

This will depend entirely on the class of fruit you wish to grow and the market you wish to supply. If you desire to grow fresh fruit for supplying Sydney or other large towns, then you must either select a site that is adjacent to these markets or that is close to a railway connecting with them, as the question of carriage is a very important item in the disposal of fresh fruit. Only very late fruit, or very choice fruit, will pay for long railway carriage, and even then it must receive extra care in handling and packing. But for this class of fruit there is always a good market—a market, too, that is nearly always secured by the fruit-growers of Victoria, South Australia, and Tasmania, instead of being supplied by our own fruit-growers. The growth of *first-class varieties of late fruits* of all kinds is one of the best openings for intending fruit-growers, and the good soils of our colder districts can produce all the fruits that we require, and for which we now depend on other colonies.

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* With notes by W. J. Allen, Fruit Expert.

If, however, you intend to go in for growing drying fruit, then soil and climate are of more importance than proximity to a market, though it is always advisable to be as near a railway as possible, as a long haul by team adds materially to the cost of production. When dealing with the different kinds of fruits I will mention the districts best suited to the growth of each, but in the meantime I must tell you how to set about getting an orchard, and how to plant the trees.

Choice of Soil and Site.

Having decided on the district in which you intend to start an orchard the first thing to do is to select a suitable site with suitable soil. This is of vital importance. Fruit will no doubt grow anywhere and in any kind of soil, but a good choice of soil and position goes a long way towards the ultimate success of the orchard.

The best site is a gentle slope to the north-east that is well protected by belts of timber or higher land from strong westerly and southerly winds. The best all-round orchard soil is a free sandy loam containing a fair proportion of decayed vegetable matter and naturally well drained—such a soil as will not stick to a spade when you are digging, or to the mouldboard when ploughing, and of such porosity that a hole dug 2 feet deep and filled with water overnight would be dry in the morning. For certain fruits, such as pears, apricots, prunes, and the better varieties of plums, a richer and heavier loam—either red or dark brown—is to be preferred, as it produces fruit of superior quality, and of a finer texture than the lighter loams, which are better suited for peaches, nectarines, Japanese plums, apples, figs, almonds, oranges, lemons, walnuts, chestnuts, &c., though all fruits will do well in such soils. The great advantage of a sandy loam soil for orchards is the ease with which it can be cultivated, and its good moisture-retaining properties, especially if it is fairly rich in decayed vegetable matter. There are any quantity of good fruit-soil and good orchard-sites available; therefore do not rush at the first chance that offers unless you are certain that it is a good one. In any case take a spade and thoroughly test the ground in several places; also test it for natural drainage, as described; for if the water will not soak away, but remains in the hole, that land requires draining before it is fit to grow most kinds of fruit properly, especially such fruits as cherries, apricots, and citrus fruits. These are all injured by stagnant water in undrained land, the first effect of which is to cause gumming, which either seriously injures or kills the tree.

PREPARATION OF THE LAND, CLEARING, FENCING, &c.

HAVING selected a site for the orchard possessing the necessary qualifications of suitable soil, shelter, situation, and accessibility, I now come to—

The Preparation of the Land.

If virgin soil is chosen—and this is, as a rule, preferable—the first operation, if it is covered with timber, is to clear it. Whatever system of clearing is adopted, it is essential that it shall be thoroughly done, and that all roots be taken out to a depth of at least 2 feet. Where the timber is small it may be most economically pulled down by a forest devil or a good team of bullocks. Even where the timber is of fair size, say up to 3 feet in diameter, if the trees are well dug under they may be easily pulled down by bullocks, the roots remaining in the land being all run to the required depth; but where there is very heavy timber, or the land is full of big stumps from which timber has been cut, the land can be best and most economically cleared by the aid of powder, as large stumps can be readily blown out if the charge of powder is placed well down in the main root, and when blown out the stumps can be burnt. Never burn any really good timber if you can possibly help it; but valueless timber should be burnt, and the ashes well spread over the land. The ground is then ready for breaking up. If the land has been well cleared, and the roots well run, then it should be ploughed as deeply as the nature of the soil will permit, but in no case should the subsoil be brought to the surface. The plough should be followed by a powerful subsoiler, so as to break up the subsoil as deeply as possibly. This will act, in a great measure, the same as if the land had been trenched by hand, as it will tend to break up any hard-pan, thus materially assisting in the drainage, and tending to aerate the subsoil. The ploughs used should be strong, and should turn the soil right over—not stand it on edge—and the ground should be left as rough as possible, and be exposed for some months before planting to the action of the weather, as this will tend to sweeten the soil. The land should be then well harrowed, with heavy breaking harrows, so as to thoroughly break up any sod in the original furrows, and it should be then cross-ploughed, and worked down fine, all roots met with in the various ploughings and workings being gathered and burnt. If the orchard is of a very uneven nature—all humps and hollows—the land should be graded before it is laid out; and if it is intended to be irrigated the grading must be most carefully done.

The preparation of the land should always be done thoroughly, as planting an orchard is not like planting a field of wheat. The orchard has to last a lifetime, whereas the wheat crop only occupies the land for a few months.

Extra care in the preparation of the land will always pay in the end, as the trees will get a better start, thrive better, come into bearing earlier, and produce more and better fruit than where no attention is given to the matter. Never plant the trees on raw unsweetened land if it can be possibly avoided. Always get the land thoroughly sweetened and into a good state of tilth first, then plant, and the trees will go right ahead. It is better to lose a season, and let the land either lie idle or take a hay or grain crop off it, than to rush the trees into the soil when it is in a totally unfit condition to grow them. The loss of time by waiting will be more than made up by the increased vigour of the trees.

Fence the Orchard well.—Do not put up a light, cheap fence, as such fences are always the dearest in the end. A good two-rail fence, or a post-and-wire fence, with the posts 7 feet apart, and six No. 8 wires, will answer well. If there are hares, wallabies, or rabbits in the district, then it is advisable to run wire netting round the fences as well. Use the best wire netting, 3 feet 6 inches wide, and of 1⅛-inch mesh, where there are hares or rabbits, and bury 6 inches of the netting in the ground to prevent the rabbits from burrowing underneath. Always place the netting on the outside, not the inside, of the fences, and see that the gates are made perfectly secure, and that they are kept closed. Netting-in the orchard is the only certain protection against hares and rabbits, and though expensive, it soon pays the cost of its erection, as these vermin will destroy an unprotected orchard. Put in good gates and sound heavy gate-posts. The gates will then hang well, and last a long time. Cheap gates are useless for orchards, as they are always getting out of repair. If there is no shelter, plant a good belt of timber-trees as a windbreak. It will be money well laid out.

Laying out the Orchard.

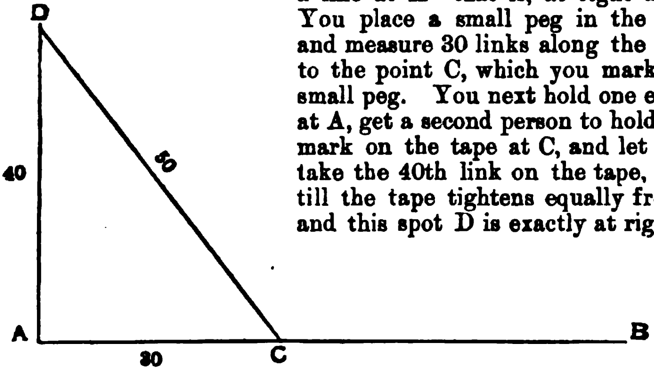
As I have just stated, an orchard once planted is likely to stand a considerable time; therefore it will pay to take a little extra care to set it out in such a manner that it may be a credit both to the owner and to the district. There is no prettier sight than a well-planted and well-cared-for orchard; but a badly-planted and neglected one is an eyesore to any intelligent fruitgrower. In planting out, the trees should be symmetrically arranged, and the rows, no matter from what angle they are looked at, should be faultless. Correct planting, besides adding to the appearance of the orchard, is of the greatest assistance in the working of the ground, as the work can be done much more easily and expeditiously than when the trees are planted irregularly.

There are several systems or methods of arranging the rows in the orchard, the trees being planted either in squares, hexagons, alternating squares, or as quincunx. Personally, I prefer the square system, as it is the simplest and best for cultivation, and though more trees can be planted on the same ground if set out in hexagons, I do not think this an advantage, as the common fault is to plant too close together as it is. In order to plant in squares, the land is laid off in straight lines parallel with each other, and at an equal distance apart, and these parallel lines are crossed by similar lines, also the same distance apart, but at right angles to them. Where the lines intersect is the place to plant the tree. In planning out an orchard, the first thing is to provide yourself with a planting-wire, which can be of any length up to 500 feet that you wish, and is made as follows:—You take a length of No. 10 or No. 12 white wire, and fasten a strong ring of about 4 inches in diameter to one end of it. You then place this ring on a bar or stake that is driven firmly into the ground, and run out enough wire to give you the length you require. You then fasten a ring to the other end of the wire, which you strain tightly and keep strained by placing the second ring on a bar or stake, in a similar manner to the first ring.

You now measure the strained wire carefully, and, at the distance apart you wish to plant your trees, make marks all along the line, taking care, of course, that the distance from each ring to the first mark on each end of the wire is the same as the distance between any two marks on the wire. To make the marks on the wire, bend a piece of No. 20 copper wire round the white wire and solder it in place. This gives a mark that is easily seen, and one that will not shift or wear out. Such a planting-wire will last for years with ordinary care, and if kept free from kinks is not likely to break. In planting out it will be found to be a great saving in time, and it will ensure accurate planting.

In laying out the orchard, you select one of the longest sides as a base-line and stretch your planting-wire along it, putting in stakes at each mark on the wire. At each end of your base-line you run a line exactly at right angles to the base-line, and extending the width of the ground to be planted. In planting a large orchard a theodolite is very handy for laying off the right angles correctly; but for a small orchard you can get your right angles practically correct—if you use extreme care, quite correct—by the same means that a bricklayer uses to set his walls out straight and square. The sides of a right-angle triangle are always in the proportion of 3, 4, and 5;

therefore, if you want to lay off a line at right angles to any point on a base-line, you can do so by means of an ordinary tape measure, as shown in the following drawing :—

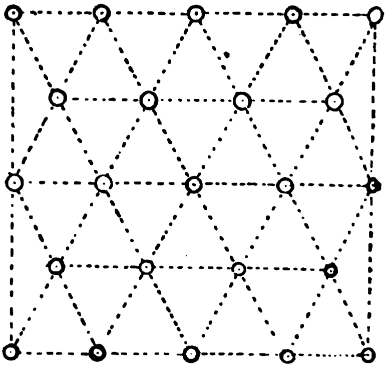


A B is the base-line, and you wish to lay off a line at A—that is, at right angles to A B. You place a small peg in the ground at A, and measure 30 links along the base-line A B to the point C, which you mark with another small peg. You next hold one end of the tape at A, get a second person to hold the 90th link-mark on the tape at C, and let a third person take the 40th link on the tape, and walk back till the tape tightens equally from both ends, and this spot D is exactly at right angles to A on the base-line A B.

Having run your base-line and two end lines at right angles to it, you can complete the fourth side of your rectangle, making it as wide as your planting-wire is long. Stake the fourth side, and then stretch your planting-wire from the second stake on your base-line to the second stake on the fourth side. Stake and then shift to the third peg on each line, and so on till the other end is reached. If you have taken your right angles correctly, and kept the wire strained equally tight all through, you will now find that the rows of stakes are in line in every direction, and the land is ready for planting the trees.

The second system is planting in hexagons, sometimes called the septuple or equilateral triangle method, and called erroneously quincunx, which is a totally different method, described later on. The hexagonal or equilateral system places every tree at an equal distance from all others, and more completely fills the ground than any other method. It has also the advantage of presenting a greater surface to the wind than a square, the outer trees thus protecting the inner ones.

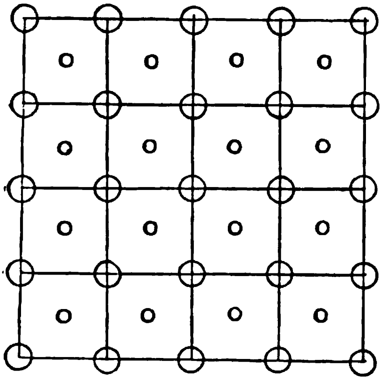
The following drawing shows the method of planting in hexagons :—



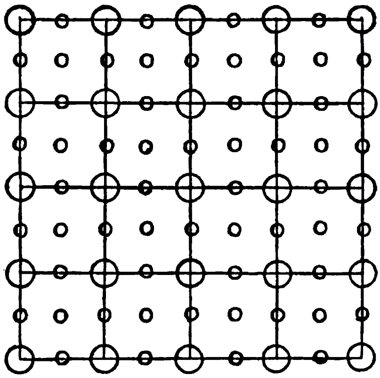
Do not plant your trees too close together, as, though you will get an earlier return from the orchard, the growth of the trees will be cramped as they grow older, and the quantity and quality of the fruit will deteriorate. With certain varieties of trees, such as walnuts, chestnuts, and strong-growing figs, it is desirable to plant the trees from 40 to 50 feet apart each way, and in this case quick-growing trees may be planted between the permanent trees till the latter require the whole of the land, when the quick-growing trees may be cut out. This is best managed by planting in one of the following manners.

1st. *The Quincunx.*—Here we have a square of four trees, at right angles and equidistant from each other, with a tree planted exactly in the centre, just where two lines drawn diagonally from the opposite corners of the square would intersect.

When the trees become too crowded, the fifth or centre tree in each square is removed. [*See drawing.*]



The Quincunx.



Alternating Squares.

2nd. *Alternating Squares.*—Here we have the four permanent trees, forming the outer angles of four smaller squares; and when the ground becomes too crowded, all the trees, excepting those that are to remain, are removed. The manner in which this is done is easily seen by referring to the above drawing.

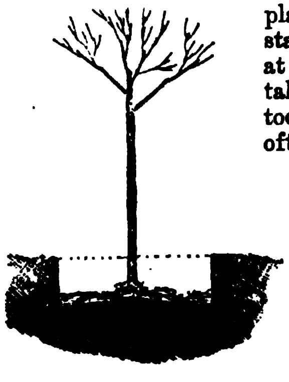
The following table shows the distance apart at which to plant various kinds of fruits, and the number required to plant an acre—square and hexagonal:—

Variety.	Distance apart.	No. of plants for square planting.	No. of plants for hexagonal planting.
	feet.		
Apples	25 to 30	69— 48	79— 55
Pears	20 to 25	109— 69	125— 79
Strong-growing cherries	20 to 25	109— 69	125— 79
Duke and Morello cherries	20	109	125
Plums and prunes	20	109	125
Peaches and nectarines	20 to 22	109— 90	125—104
Apricots	25 to 30	69— 48	79— 55
Figs	25 to 40	69— 27	79— 31
Table grapes	8 to 10	680—435	785—502
Walnuts and chestnuts	40 to 50	27— 17	31— 20
Oranges	20 to 30	109— 48	125— 55
Mandarins	16 to 20	170—109	195—125

Gooseberries and currants should be planted about 8 feet apart each way; raspberries and American varieties of blackberries in rows 8 feet apart, and the plants about 3 to 4 feet apart in the rows ; purple guavas about 10 feet apart each way; yellow guavas, persimmons, custard apples, tall-growing bananas, 16 to 18 feet apart each way; strawberries, in rows 3 to 4 feet apart, and the plants 1 foot to 18 inches apart in the rows; pineapples, in rows 8 feet apart, and the plants 1 foot apart in the row; water-melons, in hills 8 feet apart each way, and rock-melons in hills, 4 to 6 feet apart each way.

Planting the Trees.

In purchasing the trees from the nursery, care should be taken to see that they are clean and well grown, having a good root system. A medium-sized yearling tree of from 5 ft. to 5 ft. 6 in. in height from the bud, without laterals, if possible, is the best size to plant. The roots should be carefully examined, and all bruises should be cut away, taking care that the cut is made from the under side, so that when planted young rootlets will start from the cut surface at once. Care should be taken not to plant the tree too deep, as this is very often a cause of failure. The roots should be well spread out and evenly distributed round the hole, it being often a good plan to set the strongest roots in the direction of the strongest prevailing winds, as they thus tend to brace the tree. The right depth at which to plant is as near as possible the same depth as the tree stood in nursery, and the hole should be so dug that the centre is kept rather higher than the sides, so the drainage will tend to run from the base of the tree, not towards it. The above drawings show a tree properly planted (Fig. 1), and one improperly planted (Fig. 2).



Fig

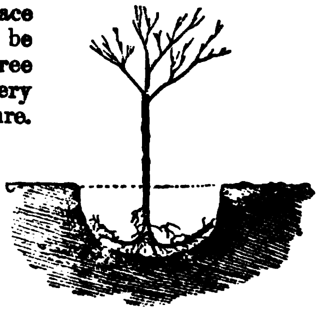
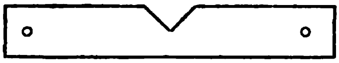


Fig.

In digging the holes keep the top soil separate from the rest, and when the hole is properly prepared, and the tree placed in position, this top soil should always be placed round the roots, as it will tend to induce new roots more quickly than the lower soil. In planting always take care that every portion of the roots comes in contact with the soil, which should be kept firm around them in order to prevent drying out. Never place any stable or other manure in the hole at time of planting, unless it is first thoroughly well mixed with the soil; even then it is not always an advantage, as it is better to place the manure round the tree as a mulch than to place it in the hole when planting.



In order to have the tree occupy the exact spot of the plastering lath or stake used in marking out the ground, the following simple device will be found very handy:—Get a piece of wood 5 feet long by 4 inches broad, by 1 inch thick. At 3 inches from each end bore a hole 1¼ inch in diameter, and exactly midway cut a V, as shown in the accompanying illustration. Get two pegs of wood of 1¼ inch diameter, a foot long, that will easily pass through the holes at the end. Smaller holes and pegs will answer just as well.

Place the board on the ground so that the stake fits into the V, and drive the pegs through the holes at the end. Then lift the board over the pegs, remove the stake and dig the hole. When ready to plant replace the board over the pegs, and place the tree so the stem will fit into the V, and thus occupy exactly the same spot as that occupied by the stake.

Cutting back at Planting.

If you want to get a strong symmetrical tree you must cut back at planting. The removal of the tree from the nursery has destroyed the greater portion of the fibrous roots of the tree, and in order that the top may correspond with the reduced roots, it must be cut back. The cutting back at planting is the first and most important step in the formation of the future tree, and the grower who neglects to do it prevents, in a great measure, the vigorous development that takes place when the tree is properly started. When a tree is planted out as received from the nursery without being cut back, there are a large number of buds on it, most of which will start, and the energies of the tree will be divided between them, the consequence being the production of a number of weakly and useless branches; but when it is properly headed back, and only three, four or five buds are allowed to develop and form the future head of the tree, then all the energies of the tree are concentrated on these buds, and the result is the production of three, four, or five vigorous shoots just where they are wanted to form the future main branches on which the tree is built, no matter what system of pruning you may wish to adopt.

Cultivation.

If you want to grow good fruit, and to make fruit-growing pay, you must cultivate your orchard thoroughly.

Keep the orchard clean. No orchardist can afford to grow a crop of weeds and a crop of fruit at the same time. If it is too much trouble to keep the orchard clean, then the best thing the owner can do is to quit growing fruit; he was not made for an orchardist, and should take up some easier line of work. Rest assured that if an orchard planted with the right varieties, in a suitable soil and district, can only pay when given thorough care and attention and kept in the highest state of cultivation and free from all fungus pests, a neglected, ill-pruned, ill-cultivated, and diseased orchard will stand a very poor chance, besides being a disgrace to the district and a propagating and disseminating ground for every kind of disease that fruit is subject to. Thorough cultivation is of the greatest importance to the orchard, as, besides keeping the land clean and friable, it is the surest way of retaining moisture in the soil during a dry time. Where uncultivated land will dry right out and be perfectly unworkable, the same ground properly cultivated will retain all the moisture necessary for the trees' growth, and, what is more, should there be a shower at any time during the dry spell, the cultivated land will absorb and retain all the rain that falls, whereas the uncultivated land will absorb little, if any, the greater portion running off the surface and being lost. Every weed growing in an orchard in a dry time is robbing the trees of the water required for their proper development; so, therefore, if for no other reason, the orchard should be kept as clean as possible. Besides this, the growth of weeds and the accumulation of rubbish in an orchard forms the best of shelters for many injurious fruit pests, and renders it difficult to deal successfully with them.

Thorough cultivation is the best remedy against drought, in that by keeping the surface of the soil in a fine state, and never allowing it to set, the surface acts as a mulch, and prevents the loss of moisture from the soil by surface evaporation. By preventing the surface soil from setting you prevent the formation of capillaries right to the surface of the land, and it is through the capillaries that surface evaporation takes place. Every orchardist knows how moist the soil keeps when covered by a mulch of straw, leaves, or bush-raking, and a soil mulch produced by thorough cultivation has the same results, and for the same reason, viz., that it prevents surface evaporation. The method of cultivation to be adopted is the same in all cases, the implements used depending on the nature of the soil and the size of the orchard.

Plough the orchard during the winter and cultivate during the summer. Ploughing tends to sweeten the soil, and to break up any pan that may be formed, as well as to bury any weeds and trash that may have gathered in the orchard after the summer cultivation is dispensed with. Plough the orchard as soon as it has been pruned, and leave it in the rough, so that any sourness in the soil may be sweetened. Plough well, the depth depending on the variety of fruit and the nature and depth of the soil. Use implements that turn the soil right over, and for this purpose the short-breasted American ploughs are the best, being easier to pull, better to handle, and doing more work than the ordinary English type of plough. In small orchards a single-furrow, one-horse plough is all that is required, but in large orchards two, three, or four-gang ploughs can be used if the trees are planted at a proper distance. All the land that can be turned over by means of big ploughs should be so treated, and that close to the trees should be ploughed with single-furrow, one-horse ploughs, fitted with special side draught, so that the whole of the land can be ploughed right up to the line of trees.

The object of summer cultivation is to stir the land, not to turn it. As I mentioned before, it is the prevention of the formation of the capillaries in the surface soil, by keeping it in a state of perfect tilth, that prevents the surface evaporation of moisture. No cultivator should be used which turns the soil or throws it up in ridges, as this will rather tend to dry out the ground by bringing moist soil to the surface, and also, the land being in ridges, there is a larger surface exposed to the influence of the sun and air than if it is left even and level. Ridges are also to be guarded against, as in the case of heavy rains, such as thunderstorms, they form channels for the water, and tend to cause washing. It is a mistake to expect the same implement to kill weeds and stir the land properly at the same time. The coulters that are best suited for stirring the land are of little value as weed-killers, as they do not cut any extent of the surface. Where weeds are troublesome they should first be got rid of by coulters made for the purpose, or by means of specially-made weed-knives.

For summer cultivation implements of the Planet Junior type, worked by one horse, and fitted with sets of teeth for surface working to kill all weeds, and with narrow cultivator-teeth to stir the lands deeply, are the best for small orchardists, whereas for large orchardists two-horse implements, such as the Planet Senior, Top-Notch cultivator or Morgan spading-harrow are to be preferred. The latter is a splendid orchard implement that reduces the surface soil to a very fine state, and consequently renders it a good mulch, as the finer the surface soil the more perfect the mulch and the less the surface evaporation. There are two great secrets in summer cultivation. The first is to work the land at the right time, and the second is never to allow a crust to form. After heavy rain the cultivators should be kept going as hard as possible—as soon as the land will carry the horses without packing—

because the sooner the surface of the soil is stirred after rain the finer will be the tilth obtained, and more moisture will be retained in the soil. Never neglect this. Remember that the more moisture you can retain in your soil in a dry district the better the returns, and neglecting to retain the moisture when you get it very often means the loss of your crop. You cannot over-cultivate if you cultivate properly. Stir the land and stir it deeply. Do not turn the soil. If you do, you bring moist soil to the surface and consequently lose moisture; therefore, use narrow teeth that stir but do not turn the soil.

PRUNING.

WHEN I wrote the first edition of a pamphlet on pruning, over six years ago, I had only been a short time in the Colony, and had had practically no experience on the subject under New South Wales conditions. I was, therefore, obliged to fall back mainly on my Californian experience, which I considered to be generally applicable here, and I accordingly recommended a system of pruning similar to that most commonly adopted throughout California. I still advocate the system that I then recommended, and am glad to say, as the result of practical experience in this Colony, that the Californian system of pruning is in the main the one that is best adapted to our conditions, and that it is the system that is coming into general use.

I have tested the system thoroughly at the Government experiment orchards, the results being so far very satisfactory, and with one or two slight modifications to specially suit our local conditions, I believe it to be the best system of pruning for this Colony.

The lack of a thorough knowledge of the principles of pruning fruit trees is shown more or less in nearly every orchard in this Colony, and this want is detrimental to our fruit industry, inasmuch as the neglect of pruning is often accountable for a large proportion of the inferior fruit produced. The object of pruning is to produce a strong symmetrical tree, bearing large fruit of fine quality protected from sunburn, evenly distributed over the tree, and so arranged as to be easily gathered. The main trunk and branches should also be protected from sunburn, and the tree should be so shaped as to be easily approached by the horse in cultivation. Pruning to produce fruit, which is so necessary in England, will seldom be required here, as our trees are naturally so prone to produce fruit that it should be more the object of the fruit-grower to reduce bearing wood, and thus decrease the burden of the tree.

This would take the place in part of thinning out the fruit, a very necessary operation where quality is desired, and one that it pays well to give thorough attention to, as it greatly improves the size and appearance of the remainder, ensuring a ready sale at good prices. Even when the market is glutted with ordinary fruit, there is always a market for anything really first-class.

Should, however, the tree run entirely to wood instead of developing fruit, then it will be necessary to prune for fruit, and this is done either by root pruning or summer pruning, as it is found that by those means the wood growth is checked and fruit spurs are developed. Root pruning should be done in winter, and it consists in cutting off all roots with a sharp spade at a distance of from 4 to 6 feet from the trunk, or, in the case of old trees, of cutting the roots on one side one season, and those on the other the next, so that the shock to the tree may not be too great, as would be the probable result if all the roots were cut at once. Root pruning is usually of most value in the case of pears and strong-growing American varieties of plums;

but, as a rule, where the orchard is at all deeply ploughed, the plough does all the root pruning required by other varieties of fruit-trees.

Summer pruning comprises pinching back laterals and converting them into fruit spurs, instead of allowing them to grow unchecked and produce unnecessary wood, which will have to be removed the next winter pruning, and also in the suppression of undesirable growths which would have to be removed afterwards, so that the energies of the tree are devoted to building up the necessary permanent branches rather than towards unnecessary growths which are of no value. Many varieties of apples and pears are greatly benefited by this pinching back of laterals, as it clothes the main limbs of the tree with a system of fruit spurs, which will bear abundant fruit in a position where the tree is best able to bear it. Summer pruning is of great value in the shaping of young trees, as will be noted under the treatment of the trees year by year, for, if neglected, the laterals that might have been converted into fruit spurs will have to be removed the following winter, and the result will be a long bare space with no fruit-wood.

Summer pruning has, however, its drawbacks, as, in the first place, it requires to be very carefully done, and necessitates the employment of skilled labour; and secondly, it requires to be done at a time when one is usually very busy.

Pruning to restore vigor to the tree is only applicable to old trees in which the root is still sound and vigorous and able to carry another crop.

The form of pruning best adapted to New South Wales conditions is a modification of what is known as the "vase" system on a low head.

This form of pruning properly carried out gives a tree strong branches, having a general upright tendency, enables it to carry fruit without assistance, and effectually shades the centre from sunburn or scald. This latter consideration is of great importance, and if neglected it leads to serious loss in a hot climate.

The height at which the tree is to be headed will be influenced by location, as it has been found by experience in California that the higher the prevailing summer temperature and the greater the aridity the lower the tree should be headed; and what applies there applies here.

The advantages of low heading are accessibility of fruit, ease of pruning, symmetry, solidity, decrease of danger from winds, and greater facility to approach the tree with the horse in cultivation. Where the trees are properly trained with low heads and obliquely-rising branches, as shown in the accompanying illustrations, one can get much nearer to them than in the case of trees headed high, with horizontal or drooping branches. These are, however, not all the advantages of low heading. Another very important thing in a hot climate is the shading of the trunk, and prevention thereby of sunburn, as well as shading the ground around the roots. It is also found that branches starting from near the ground make a more vigorous growth than when the tree is headed higher.

In order to get trees into the shape most desirable, it is necessary to commence on the young tree as soon as it is planted out. In choosing trees from the nursery, always select healthy, clean-growing trees—those with a stem free from laterals for the first 2 feet being preferable. Do not attempt any pruning before planting out, nor is it necessary to do any pruning in the nursery, as a rule, except to remove superfluous laterals in order to facilitate

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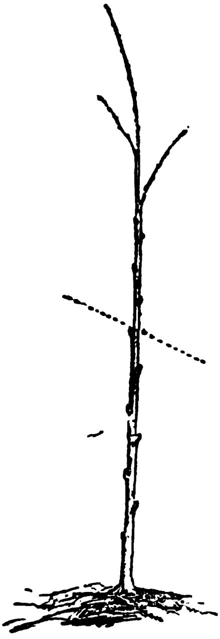
The writer is indebted to Professor Wickson's work, "Californian fruits and how to grow them," for some of the main principles referred to, which have been tested by his own practical experience, and are now applied to New South Wales.

cultivation whilst in the nursery and packing the trees when dug. If, however, the growth in the nursery is excessive it is desirable to head the tree back, and treat it as presently described.

Having secured good trees and planted them out, the first and most important step in the formation of your tree is taken. Whatever idea the grower may have as to shaping his tree, *it must be cut back when planted.* Lifting from the nursery has destroyed a part of the root system of the tree, and the top must be reduced accordingly. The grower who dislikes to sacrifice the fine top, will sacrifice future growth and vigour by retaining it. The tree may struggle through and regain vigour, but it will be for years smaller and less vigorous than if it had been properly cut back at first, and what is more, no matter how you prune it afterwards, you will never have as symmetrical a tree or one so easily pruned. I cannot emphasise this point too strongly, as on it depends, to a very large extent, the future vigour of a tree, and its capacity to bear fruit.



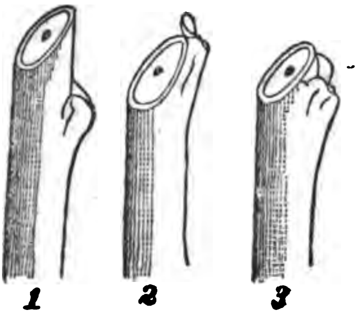
Cutting back at Planting

The height at which the head should be formed will vary, as I have previously mentioned, with climatic conditions; but, as a general rule, I prefer to head at a height of from 15 to 18 inches.

Having decided on the height, the next thing is to remove the whole of the top as shown in the illustration (cutting back at planting), taking care to cut just above a strong bud, pointing in the direction of the prevailing wind, as this will tend to brace the tree against it, and keep an upright growth. The cut by which the top is removed should be as clean as possible; and, if possible, it is an advantage for it to slope from, rather than to, the sun.

The distance from the bud at which the cut should be made is best shown by the accompanying illustrations which I have taken from Barry.

Having cut the tree to the desired height, allow the top three, four, or five buds to grow to their full extent, taking care that they come out at even distances along the stem, so as to get a properly-balanced head; and it is better for them not all to start from the same height, but for each succeeding branch to be 2 to 3 inches lower than the preceding one, as this will tend to make a much stronger tree, and one less liable to split apart.



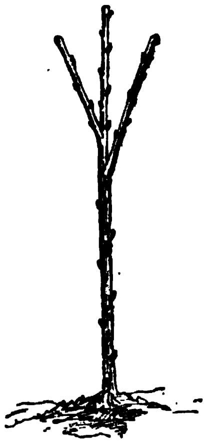
No. 1.—The cut is too far from the bud.
No. 2.—It is too close to the bud.
No. 3.—It is the right distance from the bud.

Having selected the necessary branches to form the future tree, the rest of the buds on the main stem should all be pinched back after they have made a growth of a couple of inches or so, so as to produce a tuft of leaves which will tend to protect the stem of the tree from sunburn till the top has made sufficient growth to do so. Should, however, your tree, when purchased from the nursery, have laterals along its whole length, it will be necessary to remove them all after cutting away the top, care being taken not to cut them too close, and thus destroy the strong bud at their base, which will have to produce the future limb.

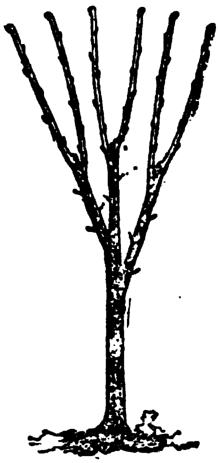
In forming the head, be sure to have the main limbs well balanced; and, as a general rule, I may say, three branches are preferable to four, and four to five.

In some cases, especially with apples and cherries, when the head is cut back to the desired height it will be found that only the top bud develops, the other buds on the stem remain dormant, and no proper head is formed. When this occurs the one branch that has started should be pinched back after it has made a growth of a few inches, and this check to its growth will cause those buds that are required to form a well-balanced head to start into growth instead of remaining dormant.

Generally speaking, it will not be necessary to do anything in the way of pruning during the first year's growth unless the wood is excessive, and there is danger of it splitting the tree, when it may be necessary to shorten in; but, ordinarily, it is better to leave the tree alone as a good root system will thus be developed, and the main stems strengthened. At the end of the year* the tree should be cut back to within from 6 to 12 inches of the original height at which it was cut, the object being to produce a thoroughly strong foundation on which to build the future tree; for, should the young wood be left on and go to fruit, though an earlier return would be obtained, the tree would break, and at three to four years would be straggling and ill-formed, requiring to be propped all round to carry its fruit, which will also be of inferior quality. And, in addition, it would be impossible to do anything with horse cultivation in such an orchard, as it would be difficult to get near the trees, thus requiring a large amount of costly and otherwise unnecessary hand labour. There is no economy in getting men to do labour at high rates which can be better and more thoroughly performed by a horse, and at a vast saving of time and money.



First Winter Pruning.



Second Winter Pruning.

The following spring, each of the three, four, or five limbs that have been left will throw out branches all along their length, and, of these, only the two upper ones on each branch, on opposite sides of the branch, and having an upward tendency, should be left. All the others, after making a growth of 2 or 3 inches, should be pinched back so as to produce a tuft of leaves, as was done on the main stem the first year, to shade the branches, and throw out fruit spurs, which will produce fruit the following year. At the end of the second year you will thus have a stocky, well-shaped, evenly-balanced tree, having six, eight, or ten well-developed branches, which will have to be shortened in to a length of 15 to 18 inches from the previous year's cut. The following spring, each of the six, eight, or ten branches are treated in the same manner as the three, four, or five branches were the previous year, that is to say, only the two top buds of each branch are allowed to grow to their full extent, all the others being pinched back after they have made a growth of 2 or 3 inches as described in the remarks on summer pruning.

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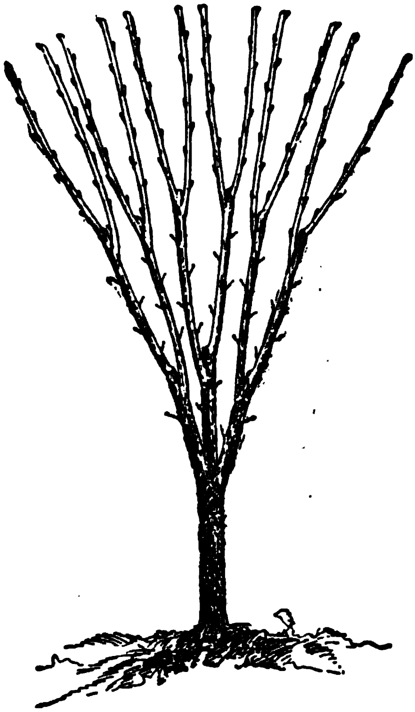
* July or August.

The results of these operations will be a strong, upright tree, of about 4 feet in height, ready to begin bearing, and one that will stand up under a fair crop of fruit evenly distributed over its branches. By this method of pruning, the orchardist will get his first fruit thirty months after setting out his orchard; but, in many, if not most instances, it is advisable to delay a year longer, as when cropping is commenced too soon, before the trees are able to stand their fruit, there is a risk of breaking them down, and also of materially injuring their future health and productiveness. It is like hitching up a raw colt and expecting to get the work of an old horse out of him, the result being he is broken down and useless just at the time when, had he been properly treated, he would have been of most value.

The following winter the tree receives its third winter pruning, and its appearance after being pruned is shown by the accompanying illustration.



Third Winter Pruning

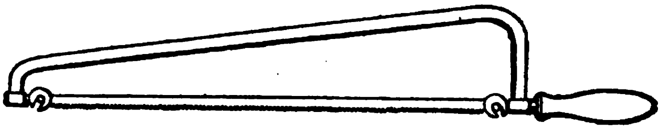
The extent to which the tree has to be cut back at this pruning will depend on the strength of the tree and the kind of fruit. Generally speaking, the less the growth, the more in proportion the cut back.

Under favourable circumstances, we shall now have a tree from 6 to 7 feet high when pruned, more if the growth has been extra, the branches of which have a general upright tendency, which will enable them to carry much more fruit than if left to straggle all over the place, and, moreover, cultivation may be carried right up to the trees. From this stage onwards the trees will only require a yearly shortening in, with the cutting out of any limbs that interfere with others, also, of course, all dead or dying branches. When it is found that the tree is of a spreading habit naturally, always, in pruning, cut to an inner bud, which will tend to confine it; and, if the tree is inclined to grow too upright, as is the case with some plums, pears, and apples, always cut to an outer bud; and, if it is desirable to continue the limb in a given direction, cut to an inner bud one year and an outer bud the next.

These general rules apply, with certain modifications, to all deciduous fruit-trees—the especial class of pruning adapted to different fruits being treated further on. With regard to the pruning of existing orchards, the following advice may be of value. In the first place, all branches, crossing or in any way interfering with any other branch, should be removed; and if the cut is a large one, it should be made with the saw, and the edges of the cut carefully trimmed with a knife, and the whole covered with grafting-wax, or a dressing of shellac dissolved in alcohol to the consistency of paint, and applied with a brush. This entirely prevents the wound souring, and, when the edges of the cut have been well trimmed, a new growth of bark will soon cover the cut. All dead, broken, or dying branches should be removed, and also all branches growing from the under side of the limbs which tend to trail on the ground, or, at any rate, open up the top of the tree, letting the sun directly on the branches, thus scalding them, and causing much dead wood. The trees should also be gone over carefully, and thinned out, or shortened in where necessary; but, at the best, if the tree has been improperly started, it is a hard job trying to pull it into anything like a decent shape.

Above all, do not leave too much wood in the tree, but thin the head out well and evenly, so as to allow the air free access, and also so that spraying may be easily and thoroughly done, as this is impossible where the branches forming the head of the tree are crowded, and such trees cannot be kept free from insect and fungus pests. The head of the tree must not, however, be thinned out too much, as it is necessary that it be sufficiently shaded to prevent the sun from striking directly on the branches in the centre of the tree, which would thus be scalded and seriously injured, if not killed.

The tools required for pruning are a good pruning-knife, a pair of 9-inch secateurs (the best that can be obtained), and a good pruning-saw. The best pruning-saw that I know of is the "California," and it is now obtainable at a moderate cost from Messrs. Lassetter & Co., Sydney, who have had these saws specially made on my recommendation. I have done a considerable amount of work with these tools, and can confidently recommend them to any fruit or vine grower, and am certain that when once used they will be always used. The illustration herewith gives a fair idea of the saw, and requires no explanation.



"California" Pruning Saw.

All heavy pruning should be done in winter when the sap is down, though citrus trees may be pruned at the end of summer, as they are then in a partially dormant state before making their autumn growth. Amongst deciduous trees plums are generally the first ready to prune, and are followed by pears, apricots, peaches, and, lastly, apples.

The general effects of pruning may be summarised as follows:—

1. Close pruning, when the tree is dormant, induces tree-growth. Hence, if a tree is feeble or has not grown as could be wished, it should be closely trimmed in the winter season, always cutting just above healthy buds.
2. A severe shock to the tree, whilst the sap is flowing freely, causes the tree to throw out fruit-buds and spurs for the next season, and pruning whilst the tree is in blossom will cause that crop to set.
3. When tree-growth is desired, prune whilst the tree is dormant; but, if fruit is desired, prune either root or top whilst the sap is flowing.
4. For plums, prunes, and apricots, leave all the small spurs growing along the branches, no matter whether the tree is young or old, for on them the bulk of the fruit is grown. Head in well from the outside, which tends to develop these spurs, and also strengthens the tree, and the fruit is grown where the tree is best able to bear it.
5. Apples, peaches, and pears are inclined to bear nearer the tips, and young trees should be well headed in during the winter season, both to give the tree symmetry and strength, and also to induce a more vigorous wood growth, and prevent a premature bearing of fruit—a fault that New South Wales fruit-growers do not seem to appreciate, but which is, nevertheless, a very serious one.

So far in my remarks on pruning I have confined myself principally to shaping the trees from the time of planting out till ready to bear, so as to get a strong, well-grown tree, able to carry its fruit without assistance, and so shaped that one can cultivate right up to the trunk with horse-power. I will now endeavour to explain, in addition, the modification of this pruning as applicable to different fruits, for, though the shaping of all deciduous fruit-trees is practically the same for the first three or four years, the subsequent pruning is entirely different in such fruits as the plum and peach. The peach bears all its fruit on one-year-old wood, whereas a plum fruits on two-year-old wood, and on the short spurs all along its branches.

Pruning the Apple.

The manner of pruning described previously applies very well to the apple. It is best to plant yearling trees, and they may be headed back to from 15 to 24 inches, according to the idea of the grower. But if headed at 24 inches care should be taken to let the first branch come out at about 12 inches from the ground, and the other two, three, or four at regular intervals above it; as, as I previously explained, this makes a much stronger tree than if all the branches start from about the same spot. I have noted this objection in most of the apple-trees I have seen in the Colony, and also the fault of allowing too many main branches to start directly from the trunk. By doing so, one never gets so strong a tree as would have been obtained had it been pruned as I described. When apple-trees are of a close, erect habit of growth, in pruning, always cut to an outer bud, as that will tend to spread the tree; and if the trees are of a naturally spreading habit, cut to an inner bud, which will tend to confine it and cause an upward growth. Even the most spreading tree, if properly pruned from the first, can be made to grow upright, and allow cultivation to be carried on right up to the trunk. The advantages of low heading apply to the apple as well as to other trees; and if the tree is started right, with a well-balanced head, and the branches well cut back to throw out strong laterals and strengthen themselves, and not allowed to crowd each other, you will have a tree come to bearing that will be strong and shapely, and that will carry its fruit within easy reach. Many apple-trees require little attention after they are once formed, but where branches several feet long are thrown out they must always be shortened in; even a tree that has been started well would be spoilt if an excessive straggling growth were allowed to remain on. Care must be taken in warm districts not to prune apple-trees too much after they are shaped, for, as a rule, they require all the foliage they can grow to protect the tree and fruit from sunburn.

The pinching of laterals, as previously recommended, is often of great value in the case of the apple, as the laterals are thereby converted into fruit-spurs, and the bulk of the crop of the tree is thus grown along the main limbs, instead of towards the end of the branches, which is often the case with this fruit. Most apple-trees produce the greater portion of their fruit on the two-year-old wood or on spurs, but in some cases most of the fruit is grown right at the end of the limbs, causing the tree to have a very straggling and untidy appearance, through the weight of the fruit bearing the limbs down. [Root-pruning arrests growth and promotes fruitfulness, and thinning crowded spurs and blossom buds favours a good set of fruit.—W. J. Allen.]

Pruning the Pear.

What I have already stated with regard to the general training of the tree, and also what I have just written respecting the apple, applies to the pear. Cutting to an inner bud when it is desirous to confine the growth and to an outer bud to spread the tree, and to an outer bud one year and an inner bud the next when it is desirous to continue the tree in a given direction, applies with equal force to the pear. Some pear-trees are of a very straggling growth, and for these no hard-and-fast rules can be laid down, all that can be done being to give the limbs a general upright tendency, and keep the tree evenly balanced by shortening-in long straggling branches. [The pear will require to be kept thinned out every winter, and cross branches taken out; and I would recommend, where it does not set well, to try pruning while the tree is in bloom, as I have noticed in some of our warmer districts that although the trees may bloom well, but few pears set. Root-pruning for such cases would be advantageous.—W. J. Allen.]

Pears are best set out as yearlings; but if larger and stronger trees are desired, two-year-olds may be planted safely, and in this case the trees should be headed as yearlings whilst in the nursery, and must be pruned on planting out similarly to the yearling trees that have been one year planted out.

Pruning the Apricot.

In the first edition of the pamphlet I described the pruning of the apricot as follows:—"The apricot is a rampant grower, and if not kept well cut back it will straggle in every direction, and either split to pieces by the weight of its fruit or be torn apart by heavy winds. Its pruning, therefore, requires very careful attention in order to get strong symmetrical trees. Low heading and an oblique upward tendency of the main branches is absolutely necessary, as is also the prevention of forks. Each branch must have a hold of its own on the main trunk, and, in order to do this, it is necessary to start them from different heights along the trunk, taking care to balance them properly. If this is not done the tree is very apt to split. The apricot is rather peculiar in its method of bearing fruit, as, like the peach, it bears on one-year-old wood, and, like the plum, on spurs of two or more years' growth. Then, again, it is peculiar in its method of growth, as each season's wood is furnished more or less along its growth with laterals, thus causing a modification in pruning, for, in addition to an annual shortening-in, it is necessary to cut back these laterals to a length of about 4 inches, thus converting them into fruit-spurs, which will bear fruit the following season. Moreover, the main weight of the fruit is distributed thereby all along the main branches, or just where it is best able to be borne. The apricot does very well with summer-pruning, effected as soon as the fruit is off the tree, so that the young wood formed will have time to harden before winter. Summer-pruning is, however, not applicable in most cases, as it comes on just at the time the fruit-grower is busiest, and, unless thoroughly done, it is better left alone, the necessary shortening-in being left until winter. Whenever it is necessary to remove a large limb, always trim the cut carefully with a sharp knife, and cover the wound with rubber paint or shellac varnish ; otherwise it is very apt to die back and ruin the tree."

Now, however, I am afraid that I did not place sufficient stress on the benefits of, or necessity for, summer pruning, as the practical experience that I have gained under Australian conditions tends to show me that in any soil that produces a heavy growth of wood it is essential to summer prune, otherwise the bearing portion of the tree is largely confined to the extremities of the branches, and, if this portion is cut back in winter, that there is then little bearing wood left. Severe winter pruning is essential for the first few years, in order to keep the tree strong and prevent its breaking apart by the sheer weight of its crop of fruit and top. Severe winter pruning is also apt to cause many buds that would otherwise remain dormant to start into laterals, and thus the main limbs will be covered with a lateral growth on which the bulk of the crop can be grown, instead of allowing these main limbs to become bare poles without fruit spurs or laterals that can be converted into fruit wood. With severe winter pruning, however, it is desirable to combine summer pruning ; thus all superfluous laterals should be removed, and those that it is desirable to leave should be shortened back to a few inches in length ; while the branches that it is wished to leave to form the future tree will then make very rapid growth. This rapid growth must be stopped by cutting back, the result of which will be to form more laterals, which in their turn must be shortened back ; and the main limbs, which have to be carried on, further cutting back will probably be unnecessary till the following winter, when the last growth is cut back to a sufficient extent to keep the limbs strong, and so prevent the tree from becoming top-heavy, By this combination of summer and winter pruning I believe the best results will be obtained, as practically all the fruit will be grown on spurs or laterals along the main branches, where they are less liable to injury from wind or sunburn, where the trees are best able to support them, and whence they are are most easily gathered.

Pruning the Cherry.

Head low, taking care not to rub off the lower buds of the trunk, but let them grow out a couple of inches or so, and then pinch back, as this gives a tuft of leaves that will shade the trunk. Young cherry-trees easily scald, and these tufts of leaves are a preventive. Scalding, even though it may not entirely destroy the tree, will cause gum, which is the most injurious disease attacking cherry-trees.

The general rules for pruning deciduous fruit-trees apply fully to cherries, but after the tree is thoroughly shaped the less pruning it gets the better, as pruning is very apt to produce gum, and consequent decay. Only broken or crossing branches should be removed, and these it will be found best to remove in midsummer, after the crop is off, when there is less likelihood of gum than at any other time. The wound should always be carefully trimmed and covered, as advised in the case of apricots.

Pruning the Plum.

Head low and cut back hard for the first four years, as the plum often makes excessive growth in a season, 8 to 10 feet being not unusual. If this growth is not cut back you have a very straggling untidy tree, the branches of which, when in fruit, will rest on or near the ground. Summer-pruning is not advisable in the case of the plum or prune, unless the growth is excessive and the young tree becomes top-heavy, in which case it is best to shorten-in the straggling growth, and thus prevent the tree from breaking apart or from getting pulled out of shape. It is found preferable to prune in winter, a stronger tree being obtained by so doing. Do not thin out the head of a plum-tree too much, but spur in all laterals and convert them into fruit-wood, so that the weight of the crop may be distributed all along the main branches, which will enable the tree to carry much more fruit than if allowed to carry its main crop on or near the ends of branches. Most plums bear their fruit on two-year-old wood.

After having got the trees into good shape, some growers allow them to go for a year unpruned, as they will in that case throw out fruit-spurs along their whole length, and only a short new growth will be made. This new growth, and a portion of the old, is cut off the following winter. Plums and prunes often do better by only being shortened in every two or three years after coming into bearing. This rule holds as well with pears, but will not do with peaches, apricots, or Japanese plums, which latter require similar pruning to peaches.

Pruning the Peach and Nectarine.

As with other fruit-trees, low heading is advisable in the case of the peach, and in order to get a strong tree it is also necessary to cut back very hard till the tree is given its desired shape. After that, a severe yearly pruning is necessary in order to produce good fruit, as peaches grow all their fruit on year-old wood. A great mistake in peach-culture is allowing the trees to bear too early, and, even when old enough to bear, in not pruning sufficiently or thinning the crop properly; for, in order to get size and quality, it is absolutely necessary to attend to this very carefully. One of the most successful peach-growers in California speaks thus of pruning the peach:—"There is no danger of pruning a peach-tree too much. Cut off nine-tenths of all the new wood, and you will then have to thin your peaches. In pruning bearing trees I leave from 4 to 8 inches of new wood, taking care to leave this on the largest, healthiest growth, as the largest limbs always produce the finest peaches. It is only by very careful pruning and thinning out that a peach-tree will remain vigorous and produce a crop of fruit every year. It is an error to cut off all inside branches as the limbs grow up, as after a few years you have quite a long limb with no lateral branches. If you will retain the lateral branches you can cut back to from 4 to 8 inches, and still you do not cut it back far enough to get a dead limb, the sap of which will eventually run down into the heart of the tree and kill it."

When peach-trees are allowed to overbear, the fruit soon becomes much smaller in size and poorer in quality, and the tree becomes enfeebled and subject to disease and the attacks of the insect pests. When a peach orchard has thus been played out by over-cropping, and the roots of the trees are still vigorous, it is often a very good thing to cut away all the old top and allow a new head to be formed.

The new varieties of Japanese plums (not the Japanese persimmon "Diospyros Kaki") require a very similar pruning to the peach, though more wood may be left on. Some of the varieties are of a large size, good quality, and their shipping and keeping qualities are of the best. I strongly recommend their being grown extensively in the warmer districts where ordinary plums do not thrive, as they do well in nearly all soils, even the poorest sands, being strong growers and very heavy bearers. I am of opinion that it will be possible to send the Japanese plums successfully to England, where they will be sure to fetch fancy prices.

Pruning the Fig.

The height of which the fig is to be headed will vary according as to whether it is required for drying or not. When required for drying it is generally advisable to head high, so that you can have a clear well-kept space under the trees from which to gather the fruit when it falls. For table-figs head low, as it is necessary to pick all the fruit. In forming the head it is best not to have more than three main branches, as it is not well to crowd. All branches starting from the under side of the main limbs should be removed, and those growing upright or slightly spreading retained. After you have got your tree into necessary shape the less pruning you do the better, except, of course, to remove dead branches, or branches that cross or in any way interfere with each other.

Pruning the Almond.

The pruning of the almond is very simple, and is confined to the shaping of the tree. Cut back hard at planting and allow three limbs to start. Do not cut out laterals, and do not head in to any extent, as the most of the fruit is grown on the laterals and long shoots, and the laterals of the almond do not die back as the laterals of the peach do. Further pruning after the shape is obtained will only be slight, and will consist in the removal of superfluous, dead, or broken branches.

Pruning of Small Fruits.

The currant and goosberry require similar pruning, except that the gooseberry requires a rather more open head than the currant. The pruning necessary consists mainly of the removal of old and worn-out wood, and in the shortening in of young growths. The suckers growing up in the centre of the bush should be removed unless the bush requires renovating, when the old wood should be cut away and the young wood should be allowed to take its place—of course always selecting the strongest and most suitable young wood and cutting away the rest.

The American varieties of the blackberry and the raspberry produce their fruit on the canes of the previous season's growth, and the canes after bearing their one crop of fruit are of no further value and must be removed. This can either be done as soon as they have done fruiting or during the following winter. If the old canes are removed after fruiting the young canes will also require to be pruned during the winter, thus necessitating two prunings. The usual plan is to cut away the old canes and top back, and thin out the young canes at the same time—in winter. These fruits are best grown either on stakes or on trellis, and in the case of the blackberry the growth is often so excessive that it is often necessary to give a summer pruning, which is quickest done by shortening in all straggling growths with a hook. The currant and gooseberry are best grown in bush form, though the currant does very well on a trellis or trained against a wall in cold climates.

Pruning Citrus Trees.

The Orange.

If the orange makes a good growth in the nursery its pruning should be commenced there, as it should be topped at a height of from 2 feet to 30 inches, which will cause branches to be thrown out, of which three evenly balanced round the stem should be chosen to form the future head—the rest being removed. Previous to transplanting, these three branches should also be pinched back so as to harden them off as much as possible, in order that the young tree may be better able to stand the shock of transplanting. Should, however, the tree not have made good growth in the nursery, its cutting back should be deferred till it is planted out, when it should be cut back and treated in a similar manner to that of the stronger tree in nursery, just described. Do not remove the leaves from the main stem of the young trees when planting out, unless a shelter of bark or other material is provided, as they tend to protect the bark from sunburn until such time as the top shades its own trunk. Having given the young tree the necessary shape for a start, the subsequent pruning is very simple, and consists in the removal of water sprouts and other superfluous branches and a shortening in of excessive or straggling growths—taking care at the same time to keep the head moderately open, but not so open as to allow the sun to shine directly on the trunk or main branches of the tree. All branches growing from the under side of the main limbs which would have a tendency to grow to or near the ground should be cut off—but beyond that and the necessary pruning just mentioned, the less the knife is used on an orange-tree the better. [It is never advisable to prune a citrus tree during the winter, as it exposes it to the cold winds and sometimes frosts, both of which are very injurious to its growth and tend to stunt it. Always try to prune just before a growth, and if any rough cuts are made, trim them off smoothly with the chisel, and paint them with rubber paint or shellac and alcohol mixed to form a paint, and apply with a brush. My experience has been that the orange-tree will not thrive in this country under the same treatment as in California. There, we went in for high-headed trees, and it answered very well, as in California we get very few high winds in summer time, whilst in warmer districts in Australia seldom a fortnight passes without one or two hot dry winds, which not only scorch the trunk of the tree if exposed, but also, in sandy districts, blow the sand against the trunk, and thus damage it.—W. J. ALLEN.]

The pruning of older trees consists mainly in the removal of dead, broken, or superfluous branches, and keeping the head fairly well thinned out. By this means the trees will be kept in good health, and will produce a fair amount of new wood annually, on which the succeeding season's crop of fruit will be borne, as the orange bears its fruit on one-year old wood only.

The Lemon.

The pruning of the lemon in nursery, and also when first planted out, is similar to that of the orange, just described. But as the lemon is often a very rank and straggling grower, it is necessary to cut back all straggling and excessive growths in order to keep the tree symmetrical, and to prevent its breaking apart from the weight of its fruit. If unpruned, the bulk of the fruit is borne on the extremities of the branches, whereas if the straggling growths are checked they will throw out laterals, and the fruit will be borne more in the centre of the tree. Straggling growths growing on to or near the ground should also be removed, as the fruit growing on them is of little value, and they give the tree a very untidy appearance. When removing a large limb always be careful to make a clean cut, and to trim the edges with a sharp knife, covering the whole of the cut with grafting-wax—rubber paint or shellac dissolved in alcohol to the consistency of paint. If this is neglected, the wound is very apt to sour and produce the much dreaded bark or collar rot, which, if unattended to, will in a short time destroy the tree.

The Mandarin.

The pruning of the different kinds of mandarins is at first similar to that of the orange, and in the case of the Emperor and Canton varieties, the subsequent treatment is very similar; but in that of the thorny mandarin it is necessary to prune much more extensively, as the tree is naturally such a compact grower that, in order to produce annual crops of good fruit, it requires a vigorous system of thinning out, so as to produce the necessary new wood on which to grow the succeeding season's crop of fruit. As a general rule, the thorny mandarin only bears a crop of fruit every other year, and then it overbears, the trees in many cases being literally covered with fruit, generally of a small size. The following season there is no crop, as the production of this heavy crop has exhausted the energy of the tree, and no new wood has been produced—so that it takes the trees a year to recuperate and grow new wood for the next crops. If, however, the trees are thoroughly pruned, instead of having a very heavy crop of undersized fruit one year and none the next, regular crops of larger fruit will be grown, which will more than pay for the extra trouble and expense of thorough and careful pruning.

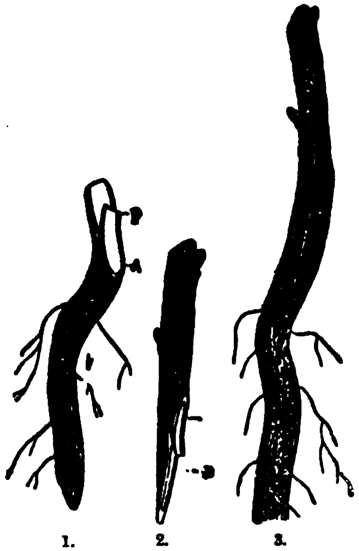
Pruning of various other Fruit-trees.

The pruning of the walnut, chestnut and loquat, consists mainly in the removal of broken and superfluous branches, and the growing of the trees at first with a general upright tendency, so as for them to be out of the way of cultivation—taking care at the same time not to expose the trunk and branches to the direct rays of the sun. The walnut and chestnut should, however, be headed higher than most fruit-trees, from 3 to 4 feet being advisable, as they become very large trees. Their shaping for the first two or three years is similar to that of other fruit-trees, but after that they require very little pruning.

The quince and cherimoyer simply require a judicious thinning out of superfluous branches, and a shortening in of excessive growths so as to maintain the symmetry of the tree The persimmon requires hard pruning, in order to produce plenty of strong new wood annually, as it bears its fruit on new wood, and the stronger the wood the better the fruit, as a rule. When pruning the persimmon, use a very sharp knife, and keep the knife clean by constantly cleaning it on a piece of leather, as the sap of the persimmon acts very quickly on the steel, which it corrodes, and if any of the corrosion is left on the cut the branch will not heal, but will die back, more or less; but if the knife is kept clean, however, no injury is done to the tree by its use. The passion-fruit simply requires to be kept in shape by the pinching back or removal of straggling vines, and old vines may be renovated by cutting back all the growth to the main stalk, and allowing a new growth to replace that cut away.

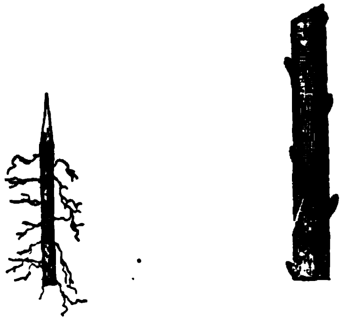
GRAFTING.

VERY few fruit-trees will come true from seed; so, in order to propagate varieties with certainty, recourse is had to budding and grafting, by means of which the desired variety is united to the stock that it is wished to convert into a special variety. There are several methods of grafting, which I will only describe very generally, but will refer anyone who wishes to obtain fuller information to the pamphlets on grafting and fruit culture that have been reprinted from the *Agricultural Gazette* at various times.



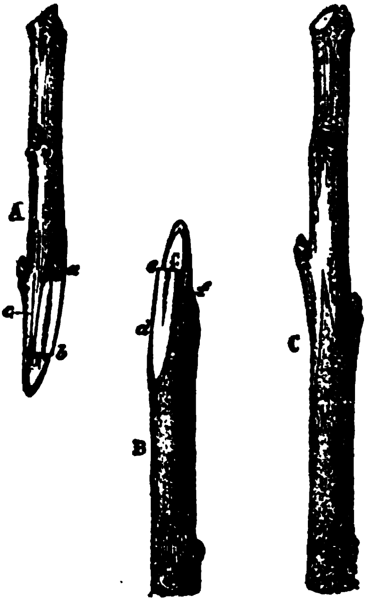
ROOT-GRAFTING.

Fig. 1.—1. The root, showing sloping cut at *A*, and the tongue at *B*. 2. The scion, showing sloping cut at *A* and the tongue at *B*. 3. The union of scion and stock ready for tying.



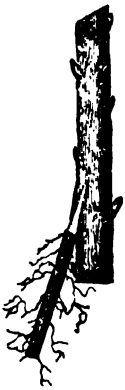
ROOT-GRAFTING.

Fig. 2.—The root. Fig. 3.—The scion.



GRAFTING NURSERY STOCKS.

Fig. 5.—*A*, the scion; *a*, the sloping cut; *b*, the tongue; *c*, shows thickness of tongue. *B*, the stock; *d*, the sloping cut in the stock; *e*, the tongue; *f*, shows thickness of stock from the cut or tongue. *C*, the scion inserted, and ready for waxing.



T-GRAFTING.

Fig. 4.—Scion, with root in position.

Root-grafting.

There are two methods of root-grafting—1st. That where the root and scion are of the same thickness; and 2nd. Where the scion is much larger than the roots.

For the first case you use the tongue graft, as shown in Fig. 1.

In the second case, where the scion is much larger than the root, then you use the root side-graft, which is shown in Figures 2, 3, and 4.

Root-grafts do not require waxing, tying with rafia or other suitable material being sufficient.

Grafting Nursery Stocks.

For this purpose by far the best method is the tongue graft. The best union is made when the stock and scion are about the same size. Stocks up to 1 inch in diameter may be successfully worked by this method, and a perfect union results.

Grafting Larger Stocks on Old Trees.

This is best done by either wedge or cleft grafting, or by grafting under the bark. The following drawings from Lelong show these methods clearly.

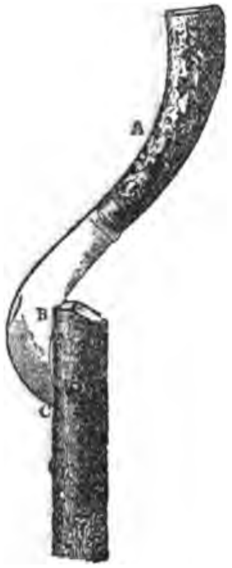


Fig. 1.—*A*, the knife as used in splitting; *B*, the point of the split; *C*, length to split; the position (shown at *B* and *C*) shows how cracking of the stocks is avoided.

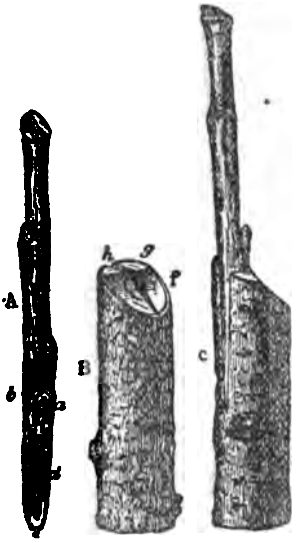


Fig. 2.—*A*, the scion, showing how it is prepared—wedge-shaped—with a sloping cut; *B*, the stock prepared to receive the graft; *f*, the sloping cut; *g*, the horizontal cut; *h*, the split; *C*, the scion inserted in the stock, showing the close fit of both, and ready for waxing.

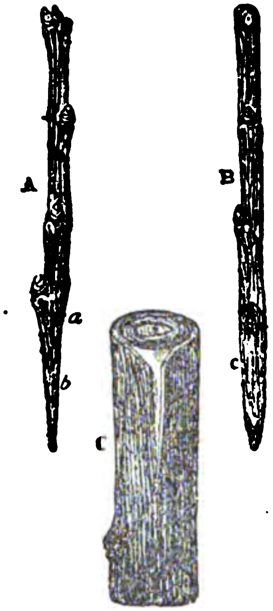
Grafting under the Bark.

For all grafts that are made above ground it is necessary to use grafting-wax, for which the following is a good receipt:—

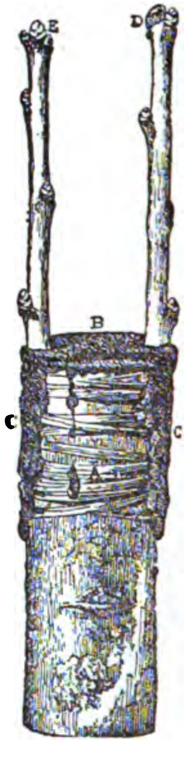
Wax	1 lb.	Resin	1 lb.
Tallow (mutton or beef)	½ lb.	Turpentine	2 oz.

Prepared as follows: Melt the resin and tallow over a gentle fire, then add the wax, and when well dissolved set aside and add the turpentine; keep stirring until the turpentine is incorporated, and it is then ready for use, or may be set aside for future use.

The grafts are first tied firmly in place by means of rafia or thin calico, the whole union being then covered with hot wax applied with a brush. For nursery grafting it is a good plan to wax the ties before using. This is done by smearing the required quantity of thin calico with hot wax, and, when cold, tearing the wax-coated calico into strips of any desired width or length.



A, the scion, side view, showing thickness of cut at points *a* and *b*; *B*, scion, transverse view, showing how faced at *c*; *C*, the stock, showing how it is cut off, and the incision made to receive the graft.



OPERATION COMPLETE.—Stock grafted with two scions, and applicable to stocks with one scion. *A*, twine, showing how it is tied; *B*, waxed top surface; *C*, waxed on the side, covering graft; *D*, graft waxed at the end; *E*, terminal bud, waxing at end not required.

These strips are bound round the grafts securely. The heat of the hand is sufficient to cause them to adhere and to form the air-tight covering which is necessary to enable the graft to unite with the stock. Peaches, nectarines, and soft-wooded trees are most successfully grafted below the ground, or at any rate low enough down to permit the soil being banked round them with a hoe; but apples, pears, and plums can be worked at any desired height. In grafting always use very sharp knives and make perfectly clean cuts—the less you hack about the stock or the graft and the quicker you complete the operation the surer the take.

Grafting is done in the spring just as the sap begins to rise, the stock being, if possible, more advanced than the scion. Grafting under the bark, however, is done when there is a full flow of sap and the bark runs freely.

[The range in grafting for fruit-trees in ordinary culture is—apple on blight-proof apple stock (Northern Spy or Winter Majetin); pears on seedling pear stock for standard tree, or on quince stock if dwarfed; peach on peach; apricot on apricot; plum on myrobalan; nectarine on peach; almond on almond (but never bud either apricot, peach, or nectarine on almond stock, as it will always result in a failure); cherry on cherry; orange and lemon on orange stock—preferably sweet or bitter.—W. J. Allen.]

Budding.

[Condensed from Mr. Lelong's article in the *Agricultural Gazette*, July, 1894.]

The process of budding is performed during the growing periods of the various kinds of trees. The peach, cherry, almond, apricot, plum, &c., are budded as soon as the scions, or buds, have developed or matured in the spring or mid-summer, and if budded early they can be started the same season, but if budded late they have to be left dormant through the winter. The apple, pear, quince, &c., are budded in the summer, and as they do not grow as rapidly as the peach, almond, &c., they are left to lie dormant till the following spring, when they are started. The orange, lemon. lime, citron, &c., are budded all through the summer, from early spring. The best time, however, is just as the sap begins to rise. The buds at that time "take" more readily, and the growth is undisturbed through the growing period of the tree. The fig, walnut, chestnut, &c., are budded during the summer, and the buds left to lie dormant, to be started in the spring. The olive and other evergreen trees of this kind are budded from the time the sap begins to rise in the spring until late in the fall. If budded early, they are started and make good growth the same season. If budded late, they must be left to lie dormant till the spring following, when they are started.

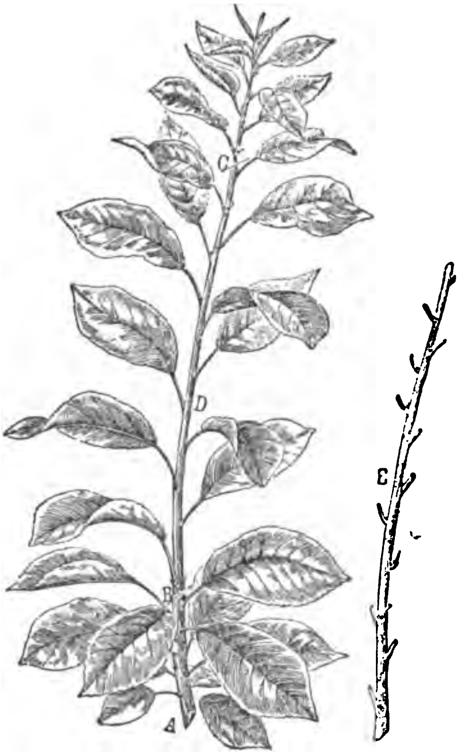


Fig. 1.—A, the point which should not be used, as the buds are generally blind; B, point from where the buds are developed; C, beyond this point the buds are too tender, and should not be used; D, indicates the scion, or budding-stick, to be used, being between points B and C; E, the scion, or budding-stick, trimmed ready for budding.

Budding the Peach.

The budding of the peach is, perhaps, the most simple. The buds take more readily, and less care and practice are required than in budding other trees. The first important factor is the selection of scions, or buds. The illustrations (Fig. 1) furnish a good example of the budding-sticks and the method of preparing them for budding. The budding-sticks or buds having been prepared, they are placed in a box, and covered either with wet sacks or moss. In taking them to the field it is advisable to never allow the sun to strike them. A small, shallow box, with a layer of wet moss at the bottom, on top of which the buds are placed and covered with a wet burlap sack, is much preferred. As the operator proceeds, only one stick is taken out and used at a time. The operation is performed with a sharp knife, called "budding-knife." Fig. 2 represents a favourite style. There are others that are also very good, such as the IXL, or Wostenholm.

A vertical incision is made in the bark of the young tree by simply pressing the point of the knife against the bark and drawing it up, making a

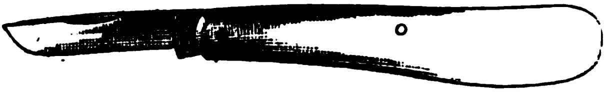


Fig. 2.

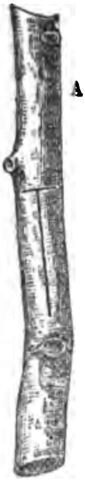


Fig. 3.—A, the stock; B, the transverse cut; C, the vertical incision.

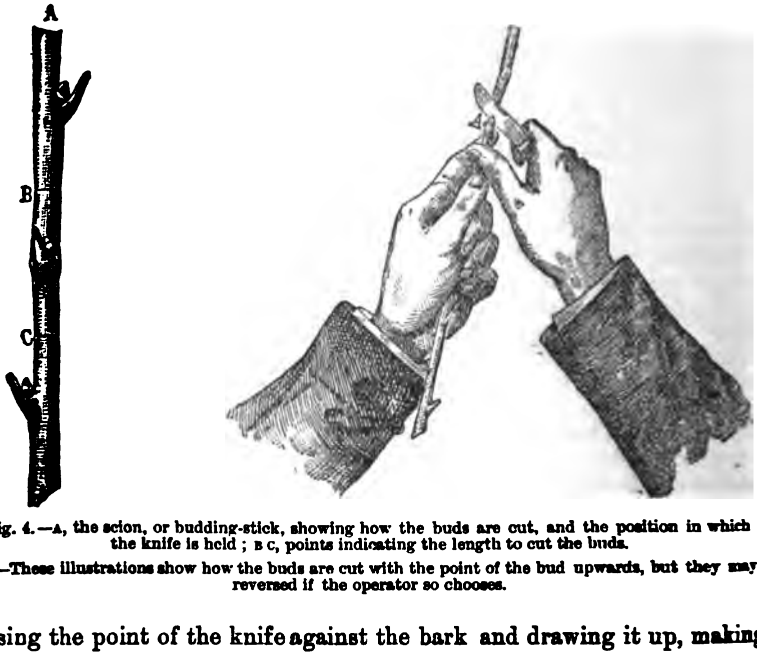


Fig. 4.—A, the scion, or budding-stick, showing how the buds are cut, and the position in which the knife is held; B C, points indicating the length to cut the buds.

NOTE.—These illustrations show how the buds are cut with the point of the bud upwards, but they may be reversed if the operator so chooses.

cut from about one-quarter to one-half of an inch long; then, by placing the knife transversely, and with a slight twist of the hand from left to right, the transverse cut is made (Fig. 3). At the same time the edges of the bark become loosened, so as to easily admit the bud; then by pressing the bud it will work its way downwards in the slit until it reaches a firm position, and the bark covers it tightly. The buds are then tied firmly with good, soft, cotton twine, and left in that position until the time comes for the strings to be cut, or the buds started or left to lie dormant, as will be explained later on.

The cutting of the bud from the stick becomes an important factor. The bud should not contain too much wood, and should not be cut so thin that when tied it is squeezed into nothing. For this reason it is always advisable to use large and plump buds. The stick is held firmly with the left hand and the bud cut with the right, as shown in Fig. 4.

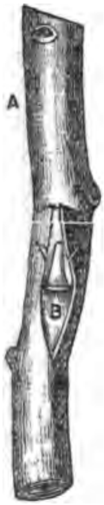


Fig 5.—A, the stock; B, the bud inserted.

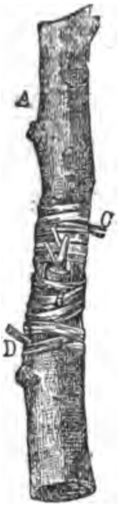


Fig. 6.—A, the stock after budded; B, the twine as tied; C, the tie at the finish; D, the tie at the beginning.

The bud is then inserted in the slit or incision, as shown in Fig. 5. The bud is then tied; for this purpose good, soft, cotton twine is the best. The work can be done more expeditiously, and the results will always be more satisfactory than when other materials, such as cloth strips, &c., are used. Many tie differently from others. Some prefer to commence the operation by wrapping the twine below the bud first, and wrap until the top is reached. I much prefer to begin the wrapping above the bud and finish at the bottom. It is of great advantage, because the bud will not slip while being tied, and it is kept in position, and instead of allowing it to slip or relax, drives it down further into the slit, and in this way a most perfect fit is obtained. The principal and most important part of the operation lies in tying the buds well, for if they should be tied loosely the air gets between the bud and the inner bark of the stock, causing the sap between them to dry and prevent adhesion. Fig. 6.

If the weather is favourable, the strings can be cut in fourteen days. In case there should be a continuance of heat it is better to leave them undisturbed for another week, because the heat sometimes causes the bark to open and the buds to dry out. In the summer young peach-trees grow very rapidly, and sometimes the strings will cut into the bark, and in this way many buds are lost; therefore, they should not be neglected, and the strings should be cut at the proper time. It is always advisable to insert the buds pointing one way—in the direction of the rows—so that in searching for those that miss, in rebudding, or in cutting the strings, a person need not spend time in searching to find them.

The budding of other fruit-trees, such as plums, pears, apples, apricots, almonds, cherries, quinces, is similar to that of the peach. For the budding of figs, chestnuts, olives, walnuts, and citrus fruits, which are rather more difficult operations, particulars may be obtained in special articles on these subjects appearing in the *Agricultural Gazette.*

In budding, the great thing is to have the stocks in good working order—that is to say, the bark must run perfectly, and require no forcing, while the buds must be well developed, and cut with a very keen knife, as thin as you can. The tie should always be tight at the base of the bud, as that is where the union takes place.

MANURING.

THE question of manuring is of the greatest importance to fruit-growers. In order to produce the best results with the least expenditure, it is necessary to have a thorough knowledge of the conditions that are required for the proper development of plant life, and also to know what plant foods to supply to different fruit-trees and to different soils, when to apply them, and how to apply them. In a paper of this kind it is impossible to enter fully into the science and practice of manuring, so I will therefore endeavour to treat the subject as concisely and as practically as possible, showing in the first place the necessity for manuring where the soil is deficient in any plant food, and secondly what manures to use, and the action of different manures.

The essential elements of an orchard soil are phosphoric acid, potash, lime, iron, magnesium, and nitrogen, and of these two—iron and magnesium—have seldom to be taken into account, as they are not required in large quantities by plants; besides, there are few soils deficient in these elements; but soils are frequently deficient in one or more of the other four elements, and they have to be supplied by means of manuring. Each crop demands a certain admixture of plant food, and it does not matter a bit how great the proportion of certain elements may be if there is one essential constituent deficient, or not available in a form that can be assimilated by the plant, a perfect crop cannot be produced.

In order to determine the amount of plant-food available in any given soil, it is necessary to make a careful chemical analysis, as this shows approximately whether the soil is deficient in any essential element, and, if so, what manures are best to apply to meet the deficiency. No branch of science has done more for agronomy than that of agricultural chemistry, and the science as well as the practice of manuring are based in a great measure on the analysis of the soil, and on the analysis of the plant-foods extracted from the soil by various crops. In this way it is found that certain crops of certain fruits make a heavy call on one or more elements of plant-food, whereas other crops or fruits only take a small amount of these elements, but make a heavy call on the others. Thus, before a fruit-grower can hope to make a thorough success of manuring, it is necessary for him to have a knowledge of the chemical qualities of the soil he is working, and also to know what plant-foods he is taking from the soil by the kind or kinds of fruit he is growing, as it is only a waste of time and money adding a manure (say) a potash salt to a soil already rich in available potash but deficient in nitrogen, for what is wanted by the soil is nitrogen, and no amount of potash manure would have the slightest effect in increasing the fertility of the soil.

Manures to use and their action.—As previously stated, I will only deal with the four essential elements of plant-food, viz., nitrogen, phosphoric acid, potash, and lime. I will deal with each of these in turn, and will endeavour to show how they may be most cheaply obtained, and most economically applied.

Nitrogen.—This essential plant-food is required principally for the formation of the albuminous matter of fruits, and this albuminous matter occurs in the largest quantities in the seeds or kernels of fruits; hence the value of thinning stone fruits so as to get large fruits, or more properly speaking, a large proportion of flesh to that of kernels, thereby reducing the amount of nitrogen required by the crop. Nitrogen occurs in the soil in the form of nitrates, which are found in conjunction with the organic matter of the soil. This organic matter has the power of converting ammonia, the form in which nitrogen is often applied to the soil, into nitric acid, and nitric acid forms nitrates in conjunction with potash and soda of the soil, and these nitrates are taken up by the tree and assimilated.

There are several sources from which nitrogen may be obtained as a manure, and they are as follows:—Sulphate of ammonia, dried blood, nitrate of soda, nitrate of potash, and in smaller quantities from boiling down refuse, stable manure, guano, and green crop manuring. The cheapest sources of nitrogen are sulphate of ammonia, which is a waste product from the gas-works, dried blood, and green crop manuring.

Potash.—In the case of the ash of most fruits, potash may be said to be the most important ingredient, as it forms by far the largest proportion of their ash. Many soils contain a sufficient supply of potash for the requirements of any crops, but the potash is in an unavailable state. When this is the case the potash may be liberated and rendered available for plant food, by the application of lime to the soil. Phosphatic manures have a somewhat similar effect, as by stimulating the tree into a vigorous growth, they render it better able to assimilate the potash contained in the soil. When, however, there is an actual deficiency of potash in the soil, the deficiency must be made good by special potash manures, and of these the following are the best:—Nitrate of potash, kainit, sulphate of potash, and chloride of potash. Of these the sulphate is the cheapest form of potash, and is in the form in which this element is usually applied to the soil. The price of nitrate of potash prevents its being used to any extent as a manure, either as a source of nitrogen, or potash, but where very quick results are desired, it is a very good manure to use.

Sulphate of potash is a soluble salt, which is obtained in large quantities from the crude deposits of potash salts that are found near Stassfurt, in Germany, where the supply is practically inexhaustible. Potash is rarely used as a manure by itself, but is usually applied in conjunction with nitrogenous or phosphatic manures, or both, when as a rule it produces better results than when used by itself.

Phosphorus.—Is essential to the growth of all fruits, occurring in the seeds in a much larger relative proportion than in the other part of the fruit, in which respect it is similar to nitrogen.

Phosphorus, or, as it is usually spoken of in manuring, phosphoric acid, is obtained from various sources, of which bones, phosphatic guanos, corprolites, basic slag, and the spent bones from sugar refineries, are the principal, but as far as these colonies are concerned, the only sources of importance to us are bones, and the waste from the sugar refineries.

Phosphoric acid is applied to the soil in two forms, one the insoluble, or only slowly soluble form, such as ground bones, basic slag, or ground phosphatic guano, or in the soluble form or superphosphates, where the insoluble phosphates have been treated by sulphuric acid and rendered soluble, and thus available for the plants' immediate use. Most Australian soils are more or less deficient in phosphoric acid, hence the good results that usually follow a good manuring with bone meal, but to obtain the best results it is necessary to use considerable judgment; thus insoluble, or only slowly soluble, phosphatic manures should be applied to the trees during the autumn, so that they may be rendered slowly soluble and available for plant food, while quickly soluble phosphates or superphosphates should only be applied at a period of active plant growth.

In the application of manures to fruit-trees, especially those manures which are termed "artificial," the fruit-grower should use considerable judgment, both as to the time and frequency of application, and also as to the method of distribution. As a general rule, slowly soluble manure, such as bone-meal, bone-dust, ground-bones, boiling-down refuse, &c., should always be applied to the soil some time before they are actually required for the trees' use, as they are thus acted upon by the carbonic acid contained in the water present in the soil, and are rendered available for the plants' use slowly. But soluble manures, such as superphosphates, sulphate of ammonia, nitrate of soda, nitrate of potash, sulphate of potash, chloride of potash should not be applied till the tree is in active growth, if possible, for if applied to the soil for any length of time before they are required, they are apt to be leached out of the soil by heavy rains, owing to their extreme solubility. In applying highly soluble manures, it is a good plan to give the amount required by the tree in two or more dressings at intervals of a month or two, as there is thus less likelihood of loss by leaching, and the stimulating effects of the manure are spread over a longer time. Artificial manures are best applied broadcast over the whole orchard when the roots of the trees occupy the whole of the ground, but in the case of young trees, the manure should be confined to a circle immediately around the tree, say from 6 to 8 feet from the trunk, according to the size of the tree. When applied, the manure should be harrowed in. Remember, when applying manures to trees, that it is better to maintain a constant supply of plant-food than to give a heavy dressing this year, and then miss a couple of years, as trees resemble animals in that they produce the best results when fed in a rational manner: they require a constant supply of food during all periods of active growth. It is a great mistake to give trees a highly soluble stimulating manure only, as when the stimulating effects have passed off, it is found that there is nothing in the soil to maintain the increased vigour, and consequently increased demands of the tree on the soil, and the tree in consequence goes back faster than it improved, and its condition becomes worse than if it had remained unmanured. When using highly stimulating manures, especially sulphate of ammonia, or nitrate of soda, it is always advisable to combine them with other slower acting manures, such as blood, boiling-down refuse, or bones, so that the trees have something to fall back on that will maintain the increased vigour imparted to the tree when the stimulating effects of the soluble manures are over.

Lime.—The last of the essential elements for plant-growth that we will deal with is lime, and as a rule it is not necessary to apply lime specially to the soil for its manurial value, as most soils contain enough lime for the growth of most trees or plants, and also where bone manures are used there is enough lime in these manures to supply the requirements of most crops. However, if the soil is found by analysis to be deficient in lime, then a dressing of 1 to 1½ ton of lime to the acre will have a very beneficial effect, but the chief value of lime lies not so much in its chemical value as in the mechanical effect it produces in the soil, and its power of freeing unavailable potash salts.

Boiling-down Refuse.—In addition to the purely artificial manures, there are several important sources of plant-food, and one of these I have already noted, and that is the refuse from boiling-down establishments. The refuse consists of blood, flesh, bones, pieces of skin, and offal, and is rich in nitrogen and phosphoric acid. As a rule, boiling-down refuse is not in a good state to apply directly to the soil, but is better composted, which is done as follows:—Take first a layer of good top soil, and place on the surface of the ground; if there is a tight clay subsoil, the top soil may be removed, and a layer of soil placed over the clay; a layer of refuse is then placed on the soil, and alternate layers of soil and refuse are placed one on top of the other till the compost heap is completed. If desired, sulphate of potash can be added to the heap with each layer of refuse, and the manure resulting will then contain all the elements of plant-food. After the compost heap is finished, it is carefully covered from the rain, and allowed to remain for at least six months before it is used. When it is required for use, the heap is opened up on one side, and is dug down from top to bottom, thus mixing the soil and refuse thoroughly together, when it is ready for application.

Farm-yard or Stable Manure.—This is a general manure, and contains all the elements requisite for the tree's growth; as a general rule, it is very much neglected in these colonies, and in no case have I seen it taken anything like the care of that it deserves. If kept at all, it is usually thrown into a heap anyhow, and exposed to all weathers, so that when used its manurial properties have often been washed clean out of it. Farm-yard manure to be properly made should be thrown into a heap, which should be protected from the weather, and no soakage should be allowed to run from the heap. The heap should be turned, so as to prevent the manure from burning, and to mix it, so that it will rot properly and evenly, as a well-made heap of farm-yard manure will cut out like cheese, even when there is a large amount of litter mixed with the urine and dung of the animals producing the manure. When farm-yard manure is well made and thoroughly rotted there is no fear of any weeds growing from it, but when thrown into a heap anywhere, or used fresh, stable or farm-yard manure is a frequent source of weeds. If, when turning the manure heap, it is found to be at all dry and musty, then it is necessary to damp it, either with water or, better still, with liquid manure, when a proper rot will take place. Where the soil is at all heavy, farm-yard manure has a very beneficial effect when ploughed in well or only partially rotten, as the manure tends to lighten the soil and keep it more open. Farm-yard manure should be applied to the soil by being spread on the surface and then ploughed in. For orchard purposes it should be applied at the time of the winter ploughing.

Instead of destroying all waste materials about a place, such as weeds, leaves, cleanings-up of road ditches, &c., it is a good plan to compost them with lime, when, if well turned and rotted, they will form a valuable manure for spreading round trees.

In soils deficient in nitrogen and organic matter the cheapest way to make good these deficiencies is by green-crop manuring, and for this purpose the best crops to grow are—cow-peas, field-peas, vetches, red clover, and Trifolium incarnatum, which should be ploughed in when the pods are forming, but before the seed is sufficiently advanced to germinate. All leguminous plants have the power of obtaining nitrogen direct from the atmosphere, and of storing it up in their roots, and this is especially the case with the cow-pea, so that when these crops are ploughed in they add a large amount of nitrogen to the soil, and in the case of heavy soils the organic matter tends to open up the soil and render it more friable.

There are other sources of manure that should not be neglected, of which fowl-manure and nightsoil are especially worthy of conserving. Nightsoil should be mixed with dry soil, charcoal, or peat, and it can then be placed directly round the roots of the trees, and will produce very beneficial results.

MULCHING.

THIS is an operation that is not given the attention that it deserves, for though no doubt the mulch forms a harbour for various noxious insects, there is probably no better treatment for keeping the trees healthy and vigorous. Mulching tends to keep down weeds, to keep the roots cool, and to retain moisture in the soil for the tree's use, as the absorbent properties of the soil for water are increased by the addition of organic matter. On poor white sandy soils mulching is of especial value, as the heat is radiated from such soils to such an extent as to often scald the trunk and main branches of the tree;—mulching prevents this radiation. Very heavy soils are also greatly benefited by mulching, because in dry weather they are very apt to cake and become exceedingly hard; this is prevented by mulching.

Mulching is good for citrus trees of all kinds; in fact, there is no better treatment for this class of fruit-trees. The operation may be done by means of bush rakings, consisting of more or less decomposed leaves and branches, fine top soil, compost of any kind, stable manure, rotten straw, rotten weeds or corn-stalks. If there is a difficulty in obtaining suitable material for mulching, then it will pay to grow a crop of peas, cow-peas, or other strong-growing leguminous plants, which should be cut when coming into pod, and placed round the trees—leguminous plants, besides, acting as a mulch are a valuable manure on account of the quantity of nitrogen they contain.

SPRAYING.

IN order to grow good fruit you must have healthy trees; and to have healthy trees you must spray to keep them free from disease. It is just as essential to spray fruit-trees as it is to gather the fruit, and no intelligent fruit-grower can afford to neglect this very important branch of orchard work.

It has been proved by actual experience that practically all the diseases attacking fruit and fruit-trees are capable of being successfully treated if the right remedies are applied in time. Spraying is the operation of applying these remedies. It is found that the best method of getting the remedies is to mix them with water and pump them on to the trees with considerable force in the form of a very fine spray. By this means the remedies used are much more evenly distributed, and adhere better to the tree, foliage, or fruit than if they are applied in the dry state; in addition to which far less is required. There are now many brands of spraying-machines on the market, to suit all buyers, from the man with one tree to the large orchardist with hundreds of acres; still, it may not be out of place to give the following advice to those who want to purchase a pump:—

1st. Never get too small a pump, as the more powerful the pump the better the work, and the smaller the quantity of material required.

2nd. See that the pump is easy to take to pieces for cleaning or packing, and that it is simply and strongly constructed.

3rd. See that all valves are of copper or brass, as bluestone is largely used in spraying, and it will corrode all the iron with which it comes in contact.

4th. See that you have a good supply of nozzles—for though one nozzle may be perfect for one purpose it may be useless for another. All nozzles should be interchangeable.

5th. Knapsack pumps are the best for vines, vegetables, or tobacco; but stronger pumps attached to casks or other receptacles are more suitable for orchard use.

When you have purchased a spraying outfit see that you take care of it. Never put it away dirty, but always run a bucket of clean hot water through it after using—drain the hose dry, and roll it up carefully, and clean out all nozzles. If you do this you will find that your pump will work when you want to use it. If not, the chances are that just as you want the appliance, it is out of order, and you lose the crop in consequence. There are two distinct sprayings—winter and summer—the former is done when all the leaves are off deciduous trees, preferably as soon after the tree has been pruned as possible. Winter spraying should be very thoroughly done. It is the main spraying of the year, as owing to the dormant condition of the trees you can use much stronger remedies than at any other time. The best winter remedies are those that are combined fungicides and insecticides of which the Californian sulphur, lime, and salt wash is decidedly the best.

In addition to general remedies—special remedies such as Bordeaux mixture, or kerosene emulsion can be used.

The winter spraying should always be done with a powerful pump, the material used being forced into every crack or crevice, and every part of the tree should be covered. There is no necessity, however, to swamp the tree. If fine nozzles that will throw upwards or downwards are used you will be able to get the spray over every part of the tree very rapidly and thoroughly.

Summer spraying is always done with special mixtures, and no all-round remedies such as the sulphur, lime, and salt remedies just mentioned are used. Much weaker mixtures are required, and much more care is necessary in their application so as to prevent injury to the fruit or foliage. Never spray whilst a strong drying wind is blowing if you can help it, or during a burning hot day—rather spray early in the morning or late in the afternoon if you can; though if it is a case of emergency, such as a bad attack of caterpillars or grasshoppers then you must spray away whether the weather is favourable or not, even if you do injure a few trees or vines; as it is better to injure a few than lose the whole. Sprays cannot be too fine especially when you are using arsenical poisons, as the more evenly you can get the spray over the tree, and the less you can use the better the results. Always prepare your spraying material carefully—see that it is properly mixed—is carefully strained, and is kept well stirred whilst in use. A little extra care and trouble in attending to details saves a lot of time and gives much better results. The method of making the various sprays is dealt with later on under the heading of diseases.

THINNING.

No tree should be allowed to bear more fruit than it can mature to perfection, hence the necessity for thinning over-laden trees if you want to get large fruit. The following which I reproduce from my articles on apricots and apple culture shows how these fruits should be thinned. The thinning of other varieties of stone-fruits is done in a similar manner to that of apricots only that peaches are allowed more room and smaller fruit less. Small varieties of plums or prunes will not pay to thin. Pears should be thinned when necessary.

Thinning Apples.

Where the trees are heavily overladen, the fruit should be judiciously thinned, so that the fruit that remains may have a chance to attain a fair size and develop properly, as it will then be more saleable than the undersized fruit from an overladen tree, and the tree itself will not be injured by the weight of the fruit breaking limbs, or, as sometimes happens, by splitting the main trunk, thereby seriously injuring, if not actually destroying, the tree.

In the case of many of the earlier varieties, especially cooking ones, the fruit may be allowed to develop to a sufficient size to be saleable, and then thinned, the balance of the fruit being allowed to come to maturity. In all other cases where the trees are heavily laden, and unable to properly develop all their fruit, they should be thinned as soon as the crop has properly set, and there is no further chance of any fall taking place. The amount to be thinned will depend on the kind of fruit, the nature of the soil, age of the tree, and the brittleness or toughness of the wood, as different varieties of apples vary very much in this. With large cooking varieties the thinning should be severe so as to produce a large-sized fruit, yet not so severe as to produce oversized fruit, which are usually of little value, being soft and coarse. With dessert apples, where a medium sized fruit—that is to say, a fruit not exceeding 3 inches in diameter—is required, it is not necessary to thin so severely, but as many fruit should be left on the tree as the tree is capable of growing to perfection, without breaking down or otherwise injuring it. There is another danger from over-cropping that I have omitted to mention, and that is the danger of opening the head of the tree too much by the weight of the fruit spreading and bearing down the branches, thereby exposing the inner parts of the tree to the direct action of the sun, which, striking right on the unprotected bark, is often the cause of sunburn which is usually the immediate cause of several diseases, notably scald, or, as it is generally called, fire-blight.

Thinning Apricots.

No fruit requires more careful thinning than the apricot, nor will pay better for careful thinning, for if allowed to overbear—a very common occurrence in this Colony—the trees will produce a large number of small fruits which are nearly all stone, and which are of very little value, whereas had the same trees been properly thinned they would have produced fruit of good size, that would have been valuable for canning, drying, or selling fresh. There are two ways by which the fruit can be thinned: the first of which is to so prune the tree in such a manner that no more fruit-wood is left than is sufficient to produce the quantity of fruit that the tree is able to grow to perfection, and the pruning that I have described in the previous part of this article shows how this can be done. The second way is to thin by hand as soon as the last drop is over—that is, after the drop which occurs when the stone is forming has taken place. Sometimes this drop is sufficient thinning in itself, in which case it is not necessary to thin further, but if too large a quantity of fruit has set, then it must be thinned. No hard and fast rules can be laid down for thinning apricots, the quantity to be left depending on the soil, climate, and the vigour of the tree. In some cases at least three-quarters of the fruit must be removed, and even then the tree will have as many fruits left as it can mature properly, whereas in other cases only a very slight thinning, or none at all, is necessary. The more vigorous the tree and the better the soil the more fruit it is able to mature. The fruit-grower must use his own judgment in the matter, and if he is an observant man he will soon learn how much fruit the tree is capable of producing properly, and when and how much a tree requires to be thinned.

In thinning gather the fruit, don't knock it off with poles; pull off all the smallest fruit, and thin evenly all over the tree, not all on one side and none on the other. Thinning pays well, as 200 lb. of good fruit on a tree will sell for more money than 500 lb. of rubbish, which is hard to dispose of at any price. There is another great consideration in thinning the fruit, and that is that the strain on the trees' energies is very much lessened, and the plant-food removed from the soil by the crop is very much less, as it takes much more out of the land to form the stone than it does to form the fleshy portion of the fruit, because the kernel of stone-fruits always makes a heavy call on the soil for phosphoric acid and nitrogen, the two principal plant-foods that have to be kept up in the soil by manuring. Thin a few trees to see whether it pays or not, and I have little doubt that you will continue to thin, as the increased size of the fruit renders it much easier to dispose of, and the extra price obtained will more than pay for the expense of thinning.

GATHERING.

SIMPLE as the gathering of the fruit seems, it is nevertheless a very important operation, and one that it will pay the growers to attend to thoroughly, especially where the fruit has to be sent some distance to a market, or where it is intended for export or for storing for our own local markets. Always gather the fruit carefully, bruising it as little as possible, as a bruised fruit is always a blemished fruit, which detracts from the appearance, and consequently the selling value of the whole case, and in the case of most varieties of fruit, bruising produces an early decay. Even where there is a market for the fruit as soon as it is gathered, handle it carefully; it will both look and sell better. Except in the case of early and some varieties of midseason apples, which can be gathered and marketed when only partially ripe, all apples should be allowed to remain on the trees till fully grown, in order to develop their full flavour and quality, which will be matured by storing. Keeping varieties of apples, if gathered when immature, will always shrivel, but early varieties, when left on the trees too long, will become dry and mealy. Actual experience is the only means by which the grower can determine the exact time or stage at which to gather the fruit, as variety, soil, and climate have always to be taken into consideration; but a good general rule to go by is—gather early fruit before thoroughly ripe, or it will become mealy, but allow late varieties to become thoroughly developed, or they will shrivel and not mature their full flavour when stored.

Pears should be gathered as soon as they have lost their woody flavour and have developed sufficient sugar. They should never be allowed to soften on the tree; if so, they will be either dry and mealy or rotten at the core, or both. Peaches, plums, nectarines, &c., should be gathered before they soften, even for the local market, as they are so easily bruised. When required for shipping to other colonies, they should be gathered even sooner, and only the firmer varieties should be sent; but where required for drying, the fruit should be allowed to become quite ripe. The following, which was written especially with regard to apricots, applies to peaches, prunes, plums, and nectarines:—

The purpose to which the fruit is to be devoted determines the stage of ripeness at which it should be gathered. When required for drying it should be allowed to become thoroughly ripe, but not dead ripe or mushy, as then it will not keep its shape when cut, and if gathered too green the fruit will dry light and be acid, as the sugar is not fully developed. For canning, the fruit must be gathered whilst still firm, just before the softening takes place, or it will not keep its shape whilst cooking, and for shipping long distances or for pulping it must be gathered even sooner. In gathering the fruit do so carefully, and don't bruise it any more than you can help. Use step-ladders; don't get into the tree if you can help it, as if you do you destroy numbers of fruit-spurs along the main branches or just where the tree can bear most fruit without injury. Some Californian fruit-growers advocate shaking the fruit off into large sheets in a similar manner to prunes, but I don't like it, as it bruises the fruit too much, for though it works well with prunes, which have a tough skin, it spoils other kinds of fruit. The expense of picking is made good by better market returns. When gathered for drying, the fruit should be carried in the picking-boxes direct to the cutting-tables, so that there is as little handling as possible, and where the cannery is close to the orchard the same method should be adopted.

GRADING, PACKING, AND MARKETING.

I CANNOT lay too much stress on the grading and packing of the fruit for market. Unless these most important operations are carefully attended to, the fruit will never show to the best advantage, no matter what its quality may be; and I am sorry to say that this is a matter that many of the fruit-growers of this Colony fail to appreciate the importance of, but send their fruit to market anyhow—big and little, good and bad, all mixed up indiscriminately. Then they wonder at the bad prices realised, and generally end by throwing all the blame on their agents, or running down fruit-growing generally; whereas the whole blame for their want of success rests entirely on their own carelessness.

If the fruit is required for immediate sale, after being carefully gathered it should be graded into different sizes, handled carefully to prevent bruising, and only one size of fruit packed in each case. It should be tightly, evenly, and neatly packed, and on opening the case the fruit should be equal throughout, the bottom as good as the top. When the fruit has to be sent a considerable distance, or where it is required for export, it should always be sweated a little before packing; and this is easily done by allowing the fruit to remain in the picking-boxes for two or three days, and placing the cases under cover where they will get plenty of air. Care should be taken to gather the fruit when perfectly dry, and after it has sweated it should be first graded into size, and all blemished, wormy, or otherwise imperfect fruit rigidly excluded.

The successful marketing of any kind of fruit depends mainly in the manner in which it is got up for sale—even grading, honest and neat packing, the exclusion of all blemished or wormy fruit, and the use of light, clean, neat cases, will do more to sell the fruit than anything else, as good fruit, well shown, will sell readily, even in a dull market, when the same fruit, unattractively got up, would be often unsaleable.

EXPORTING.

It is essential that our fruit-growers thoroughly realise the importance of exporting nothing but the very choicest fruits, as the markets we have to supply require nothing but the very best, and the expense of getting the fruit on to those markets is so great that no fruit, except it be of superior quality, will realise a sufficient price to cover the expense of shipping and marketing, and leave a fair margin of profit for the grower. It costs just as much to pick, wrap, pack, ship, and sell a case of inferior fruit, which will never realise enough to defray expenses, besides injuring the reputation of our fruits, as it does to send a case of choice fruit, which sells readily at a remunerative price, and tends to establish a character for our fruits that will result in a permanent and profitable trade.

The importance of exporting nothing but the choicest fruits cannot be too strongly impressed upon fruit-growers, as it is the primary and absolutely essential condition for the establishment and maintenance of a successful fruit export trade. It is the key-note of all the advice that we have received from the great fruit-houses of London and elsewhere, their invariable advice being: send us nothing but choice fruit, grade it evenly, and pack it honestly, and we will have no difficulty of disposing of it at a profit; but inferior, badly-graded, and badly-packed fruit we do not want at any price, as it is hard to dispose of, injures the reputation of the whole Colony's fruit, and only results in loss to the shippers.

In order to establish and maintain a profitable export trade in fruit, it will therefore be necessary for our growers to lay themselves out especially for this trade, and to do this it will be necessary, in the first place, to grow only such fruits as are suitable for the markets to be supplied, and, secondly, to place the fruits on these markets in such a manner that they will sell most readily and fetch the highest price. It is absolutely necessary to limit the number of varieties of fruits to be grown, and no grower who lays himself out for the export trade should grow more than six varieties of any one kind of fruit, and in most cases three varieties would pay very much better than six. Limiting the number of varieties simplifies the trade both for the grower and the buyer, as buyers always prefer to purchase certain recognised standard varieties, which are known and asked for by the fruit-consuming public, to kinds that the general public know nothing whatever about. Known varieties retail readily, and for more money, than varieties that are not generally known, and the public are chary of buying anything new in the way of fruit till the quality of the variety has become fairly established.

The following particulars and details relating to the export of fruit, which are derived from a large number of sources, and are the result of the actual experience of growers, shippers, and dealers in all parts of the world, must be strictly adhered to by our growers and shippers if we are to establish a profitable export fruit trade, that will prove a source of wealth to the Colony, and any neglect to comply with the advice given, which is based on experience, is bound to result in failure:—

1. Allow the fruit to become fully developed, but not fully ripe, on the tree before gathering; fruit too ripe will not carry. The best stage at which to gather varies considerably with different fruits, and with different varieties of the same fruit, so that it can only be determined accurately by actual experience.

2. Gather the fruit carefully, avoiding all bruising, as a bruised fruit is a spoilt fruit—in fact, a cull, and consequently is unfit for export. Gather when dry. Cut—do not shake or pull it from the trees.

3. Sweat the fruit before packing, by allowing it to remain in the picking-boxes for a few days. This will tend to get rid of the superfluous moisture of the skin, and to toughen the rind, thus rendering the fruit less liable to injury by bruising during shipment.

4. Grade the fruit thoroughly, firstly, for quality, excluding all blemished, marked, scaly, or imperfect fruit as culls; and, secondly, for size, as large and small fruit should never be packed together.

5. Wrap each fruit carefully, using a soft, light, but tough paper. The fruit must be completely covered by the paper, and the stem end should be so protected that when packed there is no chance of the stem of one fruit puncturing the fruit packed next to it. Use attractive wrapping-paper, which should be stamped with the brand of the grower or shipper.

6. Pack firmly, evenly, and neatly, so that there is no chance of the fruit shifting, but not so tight as to bruise the fruit and crush it out of shape. Only one size and quality of fruit must be packed in a case, which must be branded accordingly, as a single undersized or inferior fruit will spoil the sale of a case, or what is of more importance, the sale of the whole shipment of the same brand, should it so happen that the case containing the faulty fruit is the one to be opened when the consignment is being sold. Packing should be done in such a manner that no matter which side of the case is opened the fruit will open up so as to show to the best advantage. In the English market the case is always opened from the side, not from the end, as a larger quantity of fruit is thus exposed to view, and any dishonest packing is readily detected. If there are any small spaces between the fruit, never try and cram in a small fruit, but fill the space with white paper shavings, a layer of which it is an advantage to place in the top and bottom of the case as well, as it forms a cushion for the fruit and minimises the danger of bruising. Never use newspaper in any form, either for lining the cases or to fill up any spaces, as the printer's ink is readily absorbed by the fruit, to which it imparts an unpleasant flavour.

7. Use light, dry, clean, neat cases, having cleats on one side so as to allow for ventilation between the cases when stacked. Line the cases with streng white paper, and after packing leave the fruit for a day or two, if possible, to settle before nailing on the lid. The dryness of the case is of the first importance, and in my opinion much loss is now caused by the use of green timber for cases that are used for export.

8. Brand every case distinctly; first, to show the kind, quality, and number of fruit it contains; and, secondly, with the brand of the grower or shipper. which should be either a litho. or a stencil. Whatever brand is used it pays to have it attractive, and in addition to being attractive it should be distinct and readily distinguishable, as this will save a lot of trouble when loading and unloading the vessel, and there is little chance of the cases becoming mixed.

9. Maintain the quality of your brand. Don't think that all you have to do is to establish a reputation for your brand, and that you can then trade on

the reputation, and so work off inferior fruit. You may do so once; but you will destroy the confidence of your buyers, which confidence in a brand once destroyed takes a long time to become re-established.

10. Handle the cases carefully when shipping. Never use slings, as they bruise the fruit badly.

UTILISING SURPLUS FRUITS.

Drying and Evaporating.—Apples, Pears, or Quinces.

Drying.—The apple is easily and readily dried, and when good cooking varieties are used and the operation is well and carefully performed the result is a very saleable article, possessing all the qualities of the fresh fruit, and in a compact form that if well packed will keep for years, and may be sent to any market no matter how distant. At present we are practically dependent on America and Tasmania for our supply of dried apples, the little drying that is done in the Colony being usually of the very crudest nature. For drying, large, firm, good cooking acid apples having a white flesh are preferable, but other kinds may be dried if wished but will not turn out so well. For drying apples the following outfit is necessary:—

1st. A good combined peeler, corer, and slicer with which to prepare the fruit. (Several good patterns are obtainable in Sydney.)

2nd. A sulphurer in which to bleach the fruit when prepared.

3rd. A machine drier or evaporator with which to dry the fruit after it has been sulphured, as owing to the uncertainty of our climate especially in the best apple-growing districts it will rarely be found practicable to sun-dry to any extent, so that it is better to depend on an evaporator. Several different kinds of evaporators suitable for small orchardists are now procurable in Sydney, but if any one is desirous of going in for evaporating on an extensive scale, then it will be advisable either to import a large factory drier or else to construct a drier to meet the special requirements.

In drying apples the fruit is first peeled, cored, and sliced, and the slices laid on the evaporator trays. When the trays are full they are placed in the sulphurer with as little delay as possible as the fruit rapidly discolours after being cut. The fruit is kept in the sulphurer till properly bleached, the time for which varies with the different kinds of fruit, but it is better not to sulphur too long or the dried product will taste of sulphur. The bleaching should be long enough to whiten the fruit, but no more. After its removal from the sulphurer the fruit is placed in the evaporator where it remains till it is sufficiently dry, that is to say, until there is no longer any free moisture left in it, but the fruit should be pliable and not baked. Generally it is better to place the fruit in large boxes to sweat for a few days before packing, as during the evaporation some of the fruit is sure to be dried more than the rest and some less, and the sweating will even up the whole. When the fruit has evened up it should be packed in light clean boxes and be neatly and well got up. In drying apples it takes about a bushel of green fruit, on an average, to produce 6 lb. of dried fruit. Fifty pounds of fresh apples will produce about 30 lb. of meat and 20 lb. of refuse (core, skin, &c.) and the refuse is also dried and used for jelly-making, or it may be used up whilst fresh for jelly.

Peaches, Nectarines, or Apricots.

For drying, the fruit should always be allowed to ripen properly, for the reasons I have previously mentioned, and it is best to grade it before drying, as it is a bad plan to dry large and small fruit together. All the fruit on the tray should be as nearly as possible of the same size and the same degree of ripeness, if the best results are to be obtained. There are several graders in use which grade the fruit evenly and without bruising, and when there is a large quantity of fruit to handle, it pays to use them; when there is only a small quantity, the grading can be done by hand. When graded the fruit is cut in halves and the pit removed. The cut must be clear round the fruit from base to apex through the suture; do not cut one side and tear the other, as a clean-cut fruit always looks best when dried, the ragged edges of the torn fruit detracting greatly from its appearance. There are several machines for pitting the fruit, but, as a rule, a sharp knife in the hands of an expert pitter will answer well enough for our purpose, and the work will certainly be neater and the cuts cleaner than that of any machine. As cut the fruit is placed on trays with the cut side up, and, as soon as the trays are full, they are taken to the sulphurer. Never let the fruit stand any longer than is absolutely necessary before sulphuring, or the colour will be injured, and it will require more sulphur to fix it.

Drying Trays.

For sun-drying, the size of tray most commonly used in California, and the one that is generally considered to be the best all round tray, is 3 feet long by 2 feet wide, made as follows:—The body of the tray is of ½-inch timber, sawn redwood being the best; but in this Colony mountain ash, Richmond River pine, or Hobart palings would be the best to use, and would not be likely to give any taste to the fruit. The ends are best of ⅞-inch Oregon pine 1¼ to 1½ inches high, and the sides of ½-inch Oregon pine—a plastering lath does very well. The tray is securely nailed, and if it is desirable to make it extra strong, a plastering lath is nailed on crosswise underneath. Such a tray can be used for drying all kinds of fruit or raisins, is strong, and can be easily handled by one man. When the trays are filled with the cut fruit they are stacked on a stretcher, the number of trays to each stretcher depending on the size of the sulphur chamber, or else they are placed on trucks which are run from the cutting-tables to the sulphurer. The stretchers should be strong, and the fruit is sulphured whilst on the stretcher, so as to save handling, and, when sulphured, the stretcher is carried to the drying-ground, and the trays of fruit are then laid out to dry. Where trucks are used they are run direct to the sulphur chamber, and from there to the drying-ground. The drying-ground should be carefully chosen, so as to be as free from dust as possible, and all paths or roads leading to it should be kept covered with straw, so as to keep the dust down.* A lucerne paddock makes an excellent drying-ground, as there is little dust, and the trays resting on the lucerne stubble do not become so hot, nor is the fruit so likely to scorch, as if the trays rest directly on the ground, and there is little dust. Drying on lucerne stubble has answered very well at Mildura, and the best quality of Mildura dried apricots and peaches are very free from dust, considering that they are sun-dried fruit. When evaporators are used the size of the tray will vary with the make of the machine, and the trays, instead of being made as described for sun-drying, are simply a framework of Oregon or other suitable timber covered with ½-inch galvanised wire netting. The preparation of the fruit and the sulphuring is exactly the same for evaporating as for sun-drying, the only difference being that in the case of evaporating the moisture of the fruit is extracted by artificial means, whereas in sun-drying it is by natural means.

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* The disadvantage of this method is that there is a certain dampness from lucerne, especially at night, which retards the drying of fruit.

Sulphuring.

When the fruit is cut and placed on the trays, and the trays are placed either on the truck or stretcher, it must be sulphured, as the general public demand a high-coloured fruit, to obtain which it is absolutely necessary to sulphur. As to the respective merits of sulphured and unsulphured fruit, a very great deal has been said and written, so it is unnecessary to say anything further than to warn everyone against over-sulphuring. As long as the public demand a light-coloured fruit we must sulphur, but we should take care to use no more sulphur than is absolutely necessary to fix the colour of the fruit, or the quality of the article may be deteriorated and it will become less wholesome. The sulphur-chamber should be of sufficient size to meet the requirements of the orchard, and can be easily constructed by the fruit-grower himself. When trucks are used it should be of sufficient size to hold the truck, which is run direct into it from the cutting-tables, and where stretchers are used, it should be large enough to hold the stretcher without unstacking the trays. Taking the size of the trays as 3 feet by 2 feet, a sulphur chamber 6 feet long, 3½ feet wide, and 3 feet high, inside measure, would hold two stacks of trays, thirteen to a stack, or twenty-six in all, and be large enough to hold the stretcher as well as the trays, and leave room for the pan in which to burn the sulphur (A. J. Towner, Santa Ana). For this size of sulphurer Mr. Towner uses about half a pound of sulphur and sulphurs the fruit for one hour, About one pound of sulphur is sufficient for 100 cubic feet, and the time of exposure depends on the condition of the fruit; an hour, however, is usually sufficient. When the drying is on a small scale a simple sulphur chamber, consisting of an upright box made of tongued and grooved timber of sufficient width and depth to hold the trays, fitted with cleats on the sides 3 to 4 inches apart, on which to rest the trays, and having a tightly-fitting door, is all that is necessary, and will answer as well as the most expensive sulphurer.

Sweating.

Whether the fruit has been sun-dried or evaporated it should be sweated, the different sizes of fruit being placed in separate heaps. The object of sweating the fruit is to even it up and make it pliable, as during the drying some of the fruit is dried too much, and others again are not dried sufficiently, so that they are all mixed together in a heap on the floor of the fruit-room, and turned over from time to time when necessary. This process is termed sweating, and it takes from two to three weeks, when the fruit will be found to be all of an even texture. The whole of the doors and windows of the fruit-room in which the fruit is sweated must be covered with gauze-netting to keep out all moths or other insects that would lay their eggs on the fruit, and cause it when kept to become wormy.

Packing.

When sweated, the fruit is ready for packing, and is put up either in 25 or 50 lb. boxes, or in sacks holding about 90 lb. (Californian sizes). In this Colony choice fruit put up in 2½ or 5 lb. boxes showily got up should sell well, and would pay for the extra expense. Probably this would also apply to the English market, but it will only pay with the very best fruit. For ordinary grades larger boxes are preferable. In packing, line the box with white paper, placing a sheet of oiled paper on the face. Choose a quantity of selected fruit—but it must be no larger than that of the rest of the case—and arrange it in layers neatly till the bottom is covered, placing the cut side down; next fill the box till it contains the standard weight, when it should be tightly pressed down, a sheet of oiled paper placed on it, the side papers neatly folded over, and then the lid nailed down. If desirable the top can also be faced after being pressed down, but in this case the cut side must be uppermost, so that whether the case is opened either from the top or the bottom the fruit will always open well. Remember that neat, honest, and attractive packing always pays, and the better you get your fruit up the better it will sell. Always brand your cases distinctly, showing your packing brand and the quality of the fruit, and always take care to keep up the quality of your brands; it is the only way to make it pay, and by so doing you will establish a reputation for your brand that will readily sell your fruit..

Prunes.

As there are two entirely different methods of curing the fruit, one as used in France and the other in California, it is best to treat them separately. The French method, as described by J. A. Barral, is as follows, the variety referred to being the Prune d'Agen, or Prune d'Ente:—

The French Method.—In order that the prune may retain its fine qualities when cured, it is necessary that it be gathered in a perfect state of maturity and without bruising. The prunes are then spread out on wicker trays, and exposed to the sun for two days, in order to obtain a partial drying. The fruit is next submitted on the trays to three successive cookings in a common baker's oven, the first time at a temperature of 40° to 50° Centigrade (104°-122° Fahrenheit), the second time at 60° to 65° C. (140°-149° F.), the third time at 80° to 90° C. (176°-194° F.) It is of great importance that the cookings are made with regularity; that is to say, that the heat is gradually increased, so that the fruit does not crack under the influence of the heat and become spoilt. After each cooking the fruit is cooled off by exposure to the air, and turned on the trays. After the third cooking the fruits are sorted by hand to separate those that are not sufficiently cooked, and these are again passed through the oven. When the fruit is ready it is placed in a dry and well-ventilated place, and kept there till marketed. The above is an old-fashioned method, seldom used except by small growers; nearly all large growers are now using evaporators, as by this means there is a great saving of fuel, and the heat is more evenly distributed; besides, with improved methods of draught, it is possible to regulate the temperature perfectly. Evaporators also produce a better prune, and with less loss than that produced by the old-fashioned oven; one hundred pounds of fresh fruit producing as high as 40 to 45 lb. cured when an evaporator is used, but not more than 35 lb. when an oven is used. Before selling the prunes they should be graded, and for this purpose many machines answer very well, being much quicker and more accurate than hand-grading. The principal grades are—38-40, 40-42, 46-48, 50-55, 56-58, 60-65, 70-75, 80-85, 90-95, fruits to the lb.

The principal port from which the Prune d'Agen is exported is Bordeaux. The Pruneaux de Tours, made from the Saint Catherine prune, are prepared in the same manner as the Prune d'Agen, except that the fruit is passed oftener through the drier, from five to eight times, and is turned and cooled each time; the same precautions as to the gradual rise of the temperature being taken as in the case of the Prune d'Agen. The French process of curing is thus a cooking process, and results in a very dark prune with dark flesh, being thus easily distinguishable from the Californian product, in which the flesh retains its natural yellow colour.

The Californian Method.—After the fruit has been gathered, as previously described, it is usually graded before drying, as by so doing all dirt, leaves, and small twigs are removed, and the fruit being all of an equal size in each grade dries better and more evenly than if big and little fruit is mixed, in which case the small fruit will often be ready long before the large, and the product, as a result, very patchy in character.

For grading the fruit various devices are used, some of which are home-made, and others are purchased from the implement-makers. They are of different patterns, some being built as an inclined plane with adjustable slats down which the fruit runs, the different sizes falling through the different widths of slats, which are so arranged that the dirt and rubbish fall through at the top, then the smallest prunes, and so on till the largest size run over the end. A very good kind of grader is made on a similar pattern to a winnowing machine, and is provided with a strong blast, which blows out all leaves and rubbish, and the fruit is separated into various grades by wire screens of different sized mesh, each screen being set at a slight incline, so that the fruit runs into it from a spout on the side where each grade drops into a separate box. Another good, possibly the best, grader consists of a long cylindrical screen, revolving on its axis and set at an angle so that the fruit placed at one end will tend to roll towards the other. The screen is made of wire, and the size of the meshes is arranged according to the grades required. This is a very good grader for all dried fruit.

After the fruit has been graded it is dipped, an operation requiring great care, as it is one of the most important processes in the preparation of the prune. Dipping consists in immersing the fruit for about thirty seconds in boiling lye of a strength of 1 lb. of Greenbank's lye to 10 gallons of water. The lye must be kept boiling hot, and not allowed to cool by the immersion of the fruit. After the fruit is removed from the lye it is thoroughly rinsed in clean, fresh water, which must be kept constantly changed in order to prevent its becoming too much charged with lye. In order to dip the fruit it is placed in wire buckets, or galvanised pails, with perforated sides and bottom. The object of dipping is to remove the bloom and slightly crack the skin in order to facilitate drying, as otherwise the skin is so tough and of such an impervious nature that the process of drying would be a very lengthy one. The exact strength of the lye and time of immersion are to be determined by actual practice, as they differ with the ripeness of the fruit and also with the soil on which the fruit is grown. If too strong or immersed too long the prunes will be cracked too much, and in drying the sugar will exude and render the fruit sticky and bad to handle. After the rinsing in clean water, the fruit is spread out evenly on trays of about 2 by 3 feet, made of thin wood and easy to handle. It is then removed to the drying-ground, which should be so arranged that the fruit exposed will get the full benefit of the sun, and the ground should also be so situated as to be as free as possible from dust. Drying is done wholly by the sun, and the time taken will depend on the weather, and will vary accordingly from one to three weeks. In order to ensure the fruit keeping properly it should be well dried, but not so dry as to rattle like wood on the tray; the right stage at which to remove it must be learnt by actual experience. After being removed from the trays, it is taken to the fruit-house and placed in bins, where it is allowed to go through the "sweat," which requires from two to three weeks, during which time the fruit must be turned several times and carefully mixed. Going through the "sweat" evens up the fruit, so that those that were too dry absorb the moisture from those that are not sufficiently dry, and *vice versa.* The fruit also assumes a glossy appearance, and regains a certain amount of plumpness. After going through the "sweat," the prunes are put through their final process, or, as it is called, "finishing," which consists of a final bath into which the dried prunes are dipped. The bath consists of boiling water, either pure and simple, or with the addition of either salt, glycerine, glucose, prune juice, or colouring matter, which are added under the impression that they impart a superior colour and gloss to the fruit. Probably boiling water alone is as good, if not better, than any mixture. The object of the final dip is to destroy all insect eggs or insects that may have become attached to the fruit during the drying process, and also to soften the skin. The fruit should be kept in the boiling water long enough to effect this, but not long enough to cook; the exact time, as in the case of the alkaline dip, being mostly determined by actual observation. After the final dip the fruit should be dried as rapidly as possible and then packed.

Figs.

The following information is condensed from Mr. C. B. Luffmann's pamphlet, "The Fig Industry," published by the Department of Agriculture, Victoria, and refers to the true Smyrna fig:—"The fruit is never gathered. It is allowed to drop from the trees. At most the branches receive no more than a gentle shake. The fruit is then so dry that the fall to earth does not bruise or injure it. No solution of any kind is used during the drying process. When collected from under the trees the fruit is placed on dry grass, straw or rushes, which have been spread out on a dry, sweet piece of ground. After three or four days exposure to the weather it is picked up into trays and stacked under cover, whence (as soon as a sufficient quantity has been collected) it is packed in sacks and sent to market in the town of Smyrna. The fruit is not covered at night while drying, as there are no heavy dews in Smyrna during the months of August and September. Any damp weather, especially rain, is found to be most injurious, often souring the fruit and rendering it quite useless. . . . In Spain, and on the shores of the Adriatic, it is found necessary to cover the fruit at night, as in these places the night temperature frequently falls very low, and this, when the sun-heat is great during the day, is liable to cause fermentation. . . . No process of 'sweating' exists. . . . The figs are picked into classes, always with more regard to colour and appearance than size, as the packer is able to make the fig almost any shape or size he wishes. Before packing each fruit is dipped into sea-water, if procurable; if not, into salted water. This hastens the crystalisation in the fig of the sugar, which is considered so essential in the consuming markets; but this is in no way necessary for the preservation of the fruit, which keeps well in the natural state until the following hot season. With first-class fruit the pressing is done separately. The packer works the fig into the shape required by the market, and places it very firmly in the box or drum on which it is conveyed to Europe. . . . The drying crop is on the new wood. . . . No good fruit for drying can be obtained after cold weather has set in. White, cream, and pink-fleshed figs may be dried, but no *black skinned* may be used."

EVAPORATORS.

THERE are many kinds of machine driers or evaporators already on the Australian market, some of local and some of American or German manufacture. Some of the evaporators are upright, while in others the drying-chamber is on an inclined plane. In all evaporators the main principle is, however, the same, viz., that the fruit is dried by passing hot air over it, the hot dry air entering at one end of the chamber, and the moisture laden air escaping at the other. The description of the "Casula," an upright evaporator, which I give herewith, should enable any fruit-grower to put up an evaporator suitable for utilising his surplus fruits. The walls of the evaporator instead of being of brick can be of piza, adobe, or cob; if bricks are not easily obtainable; and, any of these will answer equally as well as brick. The size of the evaporator should of course be in keeping with the amount of fruit to be dried. Where there is a large quantity of fruit to handle and evaporators are necessary, it is desirable for small growers to combine, and put up one or more large centrally-located evaporators, as the cost of working such machines is very much less in proportion than the cost of working small family dryers; and, in addition, large evaporators turn out a more even sample, which can be better handled than where there is a number of small machines, and each grower does his own drying, and turns out his own fruit. Such co-operative dryers should be fitted with every convenience for handling the fruit cheaply and quickly, and should be built to suit the requirements of the district. Large growers should build evaporators suitable to their requirements, as this will be found better and cheaper than purchasing a ready-made machine.

THE "CASULA" FRUIT-DRYER.

BY P. F. ADAMS, LIVERPOOL.

So many designs for fruit-drying apparatus have been before the public during the last two or three years that some explanation in apology is requisite before introducing another.

In the subject of this article two principles are involved which I think have not been used before, at least in New South Wales—first, drawing the air for circulation in the chamber through heated pipes; and second, an improvement suggested by Mr. Benson, Fruit Expert to the Department of Agriculture, by which the draught is increased by leading the air from the top of the chamber, where it becomes charged with moisture, to the furnace—the draught up the chimney being great, as much air as it is desired to circulate through the chamber can be admitted by applying wedge-shaped stoppers to the intake passages.

When the quantity of fruit to be treated is small, say under 100 pounds per day, the draught need not be used. By removing the round stoppers from the tile-pipes in the top of the chamber the moist air will escape.

Some fruits—raisins, for example—require slow treatment; none suffer thereby; therefore, it is desirable that means be available by which to work slowly. Again, without the draught the fire can be banked by closing the door more or less. The fuel then smoulders slowly, and hours may elapse without injury through non-attention.

It will be observed that the slides for supporting the trays are usually close—3½ inches. I now wish I had made them only 3 inches apart, as I seldom use more than every alternate one except whilst shifting trays from lower to higher levels; then the double number of slides is convenient.

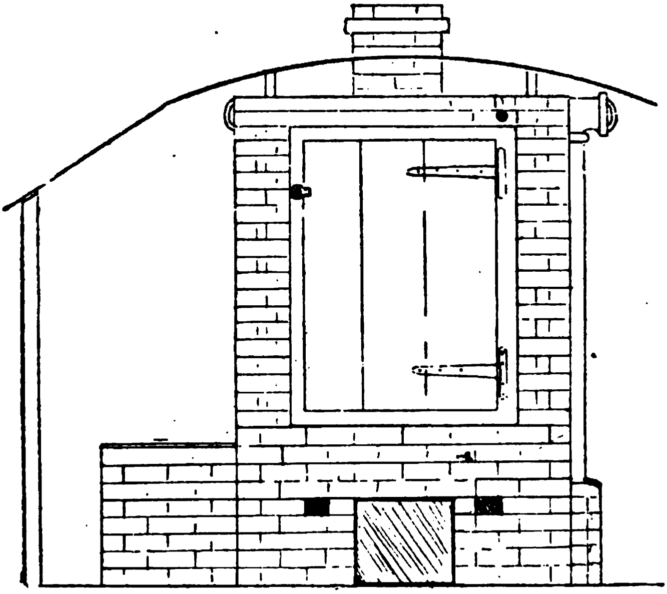


Fig. 1.—Front Elevation.

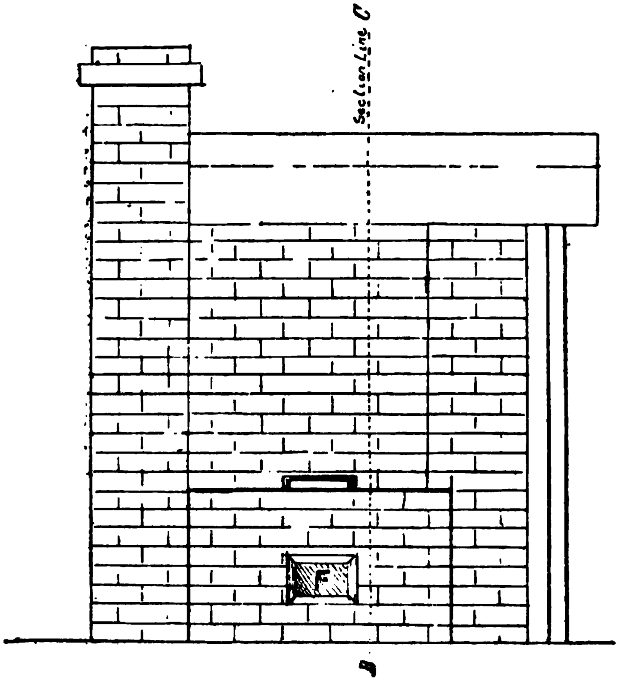


Fig. 2.—Side Elevation.
B C shows the line upon which the vertical cross-section is taken; F, door in "fume-box" to admit ladle of burning sulphur.

In many designs the heated air passes alternately under and over the trays, which are alternately drawn forward and pushed back to direct the current of air. If this method is desired, the chamber should be lengthened about 9 inches to afford space, or half the trays made so much narrower. I find that in practice it is better to employ more trays and scatter the fruit so thinly that the heated air passes upwards freely through the trays and fruit. This method has also the advantage of keeping each fruit separate at first. When heaped on the trays fruit sticks together and requires much handling. As the fruit shrinks the trays will carry three times the original charge.

The trays are of the usual pattern, 2 feet by 3, floored with ½-inch wire-netting, except a few which are done with sieve-netting and used for very small stuff—peas, for instance—also for drying-off raisins.

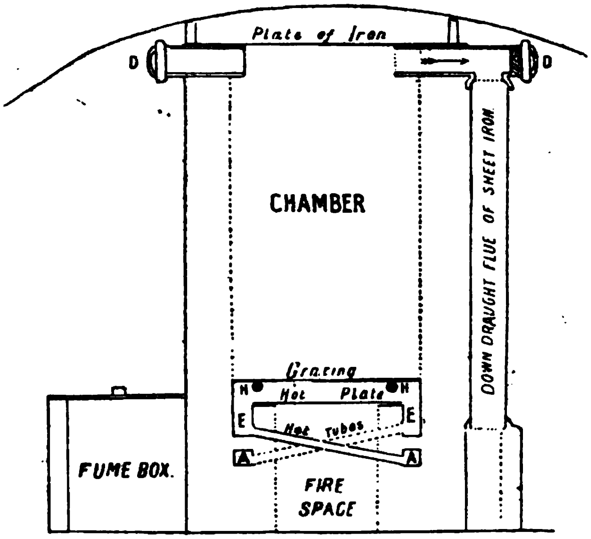


Fig. 3.—Vertical Section.

A A—Intake passages through which air passes into the "hot tubes."

D D—Wooden plugs packed with layers of flannel. When these are removed the air charged with moisture escapes. When the plugs are in, the damp air is carried by the "down-draught flue" to the fire-space and up the chimney, thereby causing a stronger current of air through the chamber.

E E—Passages into which the "hot tubes" lead and from which the heated air is distributed in the chamber.

H H—Bars of iron or tubes strong enough to bear the strain of brick wedges inserted between them and the "hot plate," to keep the latter from rising and admitting smoke to the chamber. These bars also support the grating on which the plates of tin distributing the heat rest. These plates in position assume somewhat the form shown in the diagram, "floor of chamber and distribution of heat." A little practice will show where the plates may best be placed so that the fruit will dry evenly on the trays.

In addition to the fume-box, in which the fruit is exposed to the vapour of burning sulphur, I propose erecting a small copper to be employed in dipping certain fruits in hot lye. Grapes and prunes I have not succeeded with in a satisfactory manner without dipping.

The slides for the trays are made of 1-inch angle-iron riveted to three vertical irons, one-eighth of an inch by 2 inches, the lower ends of these irons being turned outwards as feet to rest on the brickwork. The irons are further secured to the wall by wires built into it.

In construction it is necessary to take every care to prevent smoke from escaping into the chamber, especially from under the "hot plate," or covering to the fire space. In this I used thin sheet-iron (19-gauge), and prevented it from buckling by building the ends into the walls and forcing the sides down with wedges of brick inserted under the longitudinal bars or tubes (as the case may be); these appear about 3 inches above and parallel to the walls of the fire space. These walls were trowelled level on top, and asbestos tapes laid for the plate to rest on. The pressure obtained by wedging makes a smoke-tight joint and prevents the iron from buckling.

I also use a luting of clay and cow-dung to stop cracks in brickwork through which the smoke may escape.

As to cost, I cannot be certain, but I estimate it some £16. About 1,700 bricks were used, and the bricklayer was only employed six days altogether, and not continuously, on the dryer. The fire-tubes, of which there are twelve, are made of 2-inch piping, and can be obtained from a dealer in second-hand tubing for about 10s. The rest of the ironwork could be done for about £2 10s. to £3. For building material there is nothing to equal brick, because it holds the heat for hours after the fire goes out. A little practice will show how to make this after-heat available while "drying off," and so save attendance.

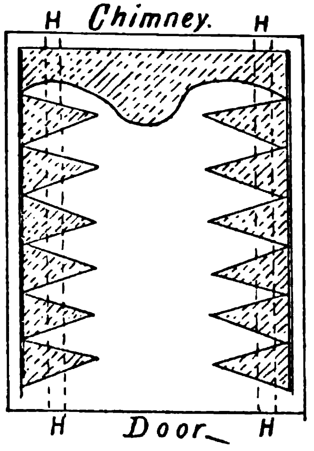


Fig. 4.—Floor of Chamber and distribution of heat. (H H—See Fig. 3).

In the course of my experiments in 1893 I proved that drying by sun heat, even when assisted by an auxiliary fire, was a fallacy as far as the coastal districts of New South Wales are concerned.

On the average, 5 lb. of fresh fruit is required to make one of dry; therefore, there is not much margin for profit on the small scale if labour is to be paid, but an orchardist who has an industrious family may turn fruit to account which would otherwise be wasted. Fruit for drying can scarcely be too ripe, if it will retain its shape on the trays. Amongst the best nectarines I dried last season the skin slipped off many in handling. Windfall fruit is often suitable best, and when washed dries well.

Again, with nectarines, plums, and some other fruits, picking is saved, the ground having been strewn beforehand with dry grass, the trees are shaken once a day, and the crop gathered up. Bruises do not show or hurt fruit for drying.

Another simple and inexpensive evaporator is described in the *Agricultural Gazette*, January, 1896. It is understood Mr. Sutton of Hornsby, the inventor, has now a stock of these evaporators.

CANNING.

1. Commercial Canning.

THIS is a business by itself, as distinct from fruit-growing as the milling of wheat is from the growing of the grain, and it requires expert labour and management to be a success. The average fruit-grower would in all probability fail to make it a success for several reasons, of which the following are some of the chief.

First—A cannery to be made to pay must be run for as long a season and as economically as possible, so as to do the largest amount of work for the capital expended in buildings, plant, &c.; and nothing but standard or extra grades of reliable quality must be put up, so that a name can be made and maintained for the excellence of the output.

In the second place, a fruit-grower would be unable to keep up a constant supply of suitable fruit from any one orchard, unless the orchard was of large size, and so planted with a selected lot of fruits, especially adapted for canning, that a constant succession of fruits, extending over as long a time as the district would permit of, could be obtained.

In the third place, the fruit-grower would have to employ a skilled canner, as it would not be possible for him to attend properly to the working of the orchard, the gathering of the fruit, and the running of the cannery at the same time.

For these reasons, the average fruit-grower, without experience, is not recommended to go in for canning as a business, as the probability is that it would end in failure. What is recommended, however, is the establishment of co-operative canneries in the centres of our principal fruit-growing districts; these canneries to be run by thoroughly practical canners, and nothing but the best grade of fruit put up. In conjunction with the canneries, fruit-drying and preserving could be also carried on without any great additional expense.

The cannery should be of a size suitable to the requirements of the district, and it will be very much better to have several small canneries in the centres of the different fruit-districts rather than one or more large canneries in Sydney, as with local canneries there will be less expense for carting the fruit and less damage to the fruit by bruising, the result of which will be a considerably greater proportion of first-class canning-fruit, and less culls, as a bruise spoils the fruit for canning. Very small canneries would probably not pay, but for about £500 a complete cannery, capable of putting up from 3,000 to 4,000 cases of canned fruit a season, could be erected, and the boiler-power necessary to do this would be sufficient to put up an equal amount of jam or jelly if wished. A drier or evaporator could be added to the cannery for an additional expense of £100 to £200, according to capacity and the requirements of the district.

A cannery of this size would consist of the necessary frame-buildings, can-making plant, 10 or 12 horse-power boiler, cooking-bath, steam-kettles, syrup-vats, cutting-tables, capping-tables, pitting-knives, parers, &c.—in fact, everything necessary for handling and putting up the fruit. The buildings need not be at all elaborate, as a plain frame-shed with a span-roof, say 60 feet by 40 feet, would be quite large enough to do all the pitting and peeling of the fruit, make the cans, cook the fruit or make jam, and, if wished, there would still be room for a dryer and for storing. A small shed adjoining would hold the boiler, and if more complete buildings were required, then stores for cases and timber as well as for the canned fruit could be erected.

Such canneries worked on co-operative lines as suggested are the only way by which the fruit-growers of this Colony will be able to dispose of their fruit to the best advantage, as the fruit suitable for canning would then be canned, that suitable for drying would be dried, and that suited for using fresh would be disposed of locally, or exported if there was a suitable surplus available.

The process of canning may be briefly described as follows:—The fruit, on arrival at the cannery, after being weighed, is given to the women at the cutting-tables. In the case of peaches the first operation is to peel them, and this is usually done with a peach-peeler, of which the "Scott" peach-peeling machine is one of the best; or if the peaches are of very irregular shape, then they are peeled by hand, using a sharp knife for the purpose. After peeling, the pit is taken out; in the case of a free-stone this is easily done—a clean cut is made longitudinally right round the fruit, and the stone then taken out; but in the case of cling-stones, especially-made pitters, of which the California cling-stone pitter is a very good type, are used, or if not, then a pitting-spoon or a cling pitting-knife is used. The latter are now obtainable in Sydney at a reasonable price. After the stone is removed, if there is a large amount of red round the pit that still adheres to the flesh, then it must be spooned out, as if left in it would colour or stain the syrup and render the fruit unsaleable.

The fruit, as cut, is carefully sorted into the different grades. All the large, firm, whole pieces are placed by themselves; all the smaller, unripe, over-ripe, and broken pieces being kept out for pie-fruit or fruit-pulp. The fruit, when cut, is taken to the filling-tables, the best fruit being placed in 2½-lb. cans (which are 4 inches in diameter by 4¾ inches high) and the pie-fruit placed either in 2½-lb. cans or in larger cans holding about 11 lb. of fruit net, which are about 6¼ inches in diameter and 9¾ inches high. Pie-fruit put up in the large cans similar to those used for fruit-pulp, and it only differs from ordinary canned fruit in that no sugar is used for its preservation.

After the cans are filled with fruit, cold syrup, made by dissolving the best crystalline cane-sugar in boiling water, is added till the can is completely filled with fruit and syrup, when it is taken to the capping-table and the lid soldered on, a small vent-hole in the centre of the cap being left.

The strength of the syrup varies according to the quality of the fruit to be put up, but all standard and extra grades should be put up in a good heavy syrup, made by dissolving about 4 lb. of sugar in each gallon of water. In addition to the sized cans mentioned, some Californian packers put up a very choice line of extra grade in 8 lb. cans (which are 4¼ inches in diameter by 4¾ inches high), but it is not a common size, and is only put up for the very best trade. The can is now placed in an iron frame or basket, which may hold anywhere from six to a gross cans, according to the size of cooking-bath, and is then submerged in boiling water long enough to drive off every particle of air contained in the can.

The vent-hole is then soldered up and the fruit cooked till it has reached the right consistency. It is in the cooking of the fruit where expert knowledge comes in, and no hard-and-fast rules can be laid down. It is simply a question of practical experience, and depends entirely on the kind of fruit, its ripeness, texture, and cooking qualities; for whereas one fruit would cook to mush in five minutes and be valueless, another will require twenty minutes, or longer, to be properly cooked and to acquire its full flavour.

Apricots are treated the same as peaches, except that the skin is left on, and too great care cannot be taken to cut the fruit well. Never cut one side and break the other, leaving a ragged edge, or the fruit will never look well —and appearance goes a long way towards selling the fruit. Pears are peeled by hand, cut in half, the cores removed, and then treated similarly to peaches. Plums are, however, treated quite differently. The pits are not removed, but the fruit is carefully graded for size and ripeness, then placed in the cans, the syrup poured on, then the lid is soldered on, but no vent-hole is left. The fruit is now cooked as usual, sufficiently long for the pressure inside the can to burst the air surrounding the pit of the plum, but of course not long enough to burst the can. The can is then taken out, a spilehole driven into it to allow the air to escape, and as soon as all the air is exhausted the tin is soldered up and the cooking finished.

All cans after being cooked are carefully tested to see that they are absolutely air-tight, and all defective cans, after the leak has been mended, are again raised to the boiling point, as no fruit will keep unless it is absolutely air-tight. The testing is easily done, an expert canner knowing at once from the sound of the can when struck whether it is air-tight or not; and the cans can also be easily tested by submerging them, after they have cooled for two or three seconds, in boiling water, when, if the smallest flaw exists, the air will be seen escaping from it. The remainder of the work is merely finishing, and consists in dipping the ends of the cans, to coat them with blue, bronze, or gold—which improves the appearance of the can; labelling, for which purpose a good showy litho. should be used; and finally packing for the market in cases holding twenty-four cans.

The pie-fruit is differently treated to the canned fruit, and as there has been a considerable number of inquiries respecting the manufacture of fruit-pulp—which is only another name for pie-fruit—it will be as well to explain how it is made.

As previously mentioned, all the small under-ripe fruit and broken pieces unfit for the standard grade are placed in cans holding about 1 lb. net. When filled with fruit as tightly as possible without crushing, water is added to cover it, the lid is put on, and a vent-hole left. The can is now placed in boiling water till the whole of the contents are raised to boiling-point, and all the air in the can has been driven off, when the vent-hole is closed, and the cooking is complete. The cans are tested the same as for canned fruit. Another process, and that evidently adopted in the case of the can of apricot pulp received by the Department from London, is as follows:—The fruit, after being cut, was all placed in the can with the cut side down, and was evenly and tightly packed, the lid being off enabling this to be done. Water was now added to cover the fruit and the can placed in a shallow vessel of boiling water, the water only coming to within about 1 inch of the top of the can. When the fruit inside the can had been raised to a sufficient temperature to drive off all the air, the lid was put on—being crimped on, not soldered—and the pulp was ready. The value of fruit-pulp is that it is a cheap means of preserving the inferior fruit that is not good enough for canning, and enabling it to be kept over to such a time as it is convenient to turn it into jam. There is one thing, however, that I must caution my readers against in making fruit-pulp, and it is this: No fruit that is unsuitable for canning, except as regards size or under-ripeness, is suitable for pulp, as it must keep its shape when cooked and not go to mush. The time to cook pulp is about twenty-five minutes, as it takes that time to get the can heated right through.

The fruits that are suitable for canning must possess the following qualities:—Firmness of flesh, which must be of sufficient consistency to keep its shape when cooked; clearness of flesh—either white or yellow flesh stained with red is unsuitable; and good flavour, which is brought out by cooking. The fruit, in the case of stone-fruits, may be either cling or free stone, but as a rule cling-stones are to be preferred, as the flesh is usually firmer than that of free-stones, and consequently keeps its shape better. The fruit should be of large size, and be gathered when fully grown, but before it begins to soften, as it will not keep its shape in cooking if over-ripe. The fruit requires to be carefully gathered and handled, so as to be bruised as little as possible, and it should be brought from the orchard to the cannery with the least delay.

2nd.—Home Canning.

Every person having an orchard should put up enough fruit during the season to supply all home requirements, as the process is by no means a difficult or costly one.

The kinds of fruit that are suitable, and their methods of preparation, I have fully described under the head of "Commercial Canning," so these remarks will be confined to the methods of conserving the fruit. In the place of cans, glass jars of different sizes and patterns are used, and the following jars (all of which are obtainable in Sydney) may be used, viz.:—The Lightning, Chicago, San Francisco, Mason's, and one or two others. After the fruit has been prepared as previously described, it is treated in one of the two following manners:—

1st. It is placed in a wide and shallow copper or enamelled vessel, and syrup or water and sugar is added to it. The fruit is then slowly raised to the boiling-point, but not allowed to boil vigorously, or it would go to pieces, and placed whilst boiling hot in the jars, which should have been previously heated in order to 'prevent their being cracked by the hot fruit, and the covers at once put on, as, in order for the fruit to keep, it is necessary that there is no air present in the jars. In order to be sure of this, it is always well to test the jars first by filling them with water; then put on the lid and turn them upside down, when it will be easily seen if they are not air-tight. If not air-tight, a new rubber should be put on, and the jar again tested. In taking the fruit from the vessel in which it has been cooked, and placing it in the jars, great care is necessary to prevent the fruit from crushing, and so lose its shape. If wished, the fruit can be cooked with water without any sugar, but I do not like the method, as it is no cheaper in the end, sugar having to be added to the fruit before it is fit to use; and in the case of any fruit that is cut or peeled nearly the whole of the flavour goes into the juice, and the fruit itself has about as much flavour as a turnip.

2nd. The second process, and the one that I advise everyone to adopt, is to place the fruit in the jars before cooking and cover with syrup, as is done in the case of cans, the fruit being evenly and well arranged in the jar—a jar having the mouth sufficiently large to admit the hand freely being the best for the purpose. The jars filled with fruit and syrup are now placed in a large oval boiler or other suitable vessel, having a false perforated bottom or some lattice-work to fit the bottom and prevent the jars coming into contact with the metal bottom, which will prevent their being broken during the cooking. Cold water is now added to the vessel until it reaches the necks of the jars, when it is slowly heated to the boiling-point, at which stage the fruit should be sufficiently cooked. The lids are placed on and fastened down as quickly as possible, and care must be taken to see that they are absolutely air-tight, as the fruit will not keep otherwise.

There is a local demand for first-class fruit put up in glass, but it must be nothing but first-class, when it will bring a very remunerative price, as there is a certain class of Sydney buyers who prefer to buy fruit in glass, and who will pay a good price for a fancy article—so that it will pay to cater for this trade.

Jam-making.

No matter how well the orchard is kept, and the trees thinned, there will always be a certain proportion of small fruit which is of no value for canning or drying, but yet will make a good jam—though first-class jam, like first-class canned or dried fruits, must be made of selected fruits, and when not making for home consumption, I should always advise its use. However, the smaller fruit makes a good jam if used when fresh, and not allowed to ferment and become partially rotten before using. The process of jam-making is a very simple one, whether for home use or at the factory. The fruit, which is best not to be over ripe, and which should be free from all rotten fruit and other rubbish, is placed in a steam-jacketed kettle, and to every 1 ℔. of fruit not less than three-quarters of a pound of the best cane sugar should be added. The fruit is then rapidly boiled till of the right consistency—that is to say, will keep its shape if up-ended when cold, and then poured into cans or glass jars and covered down at once whilst quite hot, as, in order to prevent mould forming on the fruit, it is necessary for it to be perfectly air-tight. If not sufficiently boiled, the fruit is apt to ferment, so it is always best to thoroughly cook it. When using cans, those holding about 1 ℔. are used, and the size is about 2¾ inches in diameter by 3¼ inches high, and when using glass, 1-℔. jars are generally used, which are either corked or tied down with parchment-paper; but whatever material is used to cover the jam, it is absolutely necessary, if the jam is to keep well, that it be perfectly air-tight. When jam is made for home consumption, and steam-jacketed boilers are not available, cook the fruit in shallow, wide vessels, either of copper or iron, lined with enamel, over a slow fire, stirring constantly to prevent burning, and removing all impurities that rise to the surface in the form of scum. Always use the best cane sugar—confectioners' crystals is about the best—as the jam will be clearer, firmer, and keep better than that made from a cheaper and inferior sugar.

Jelly-making.

Take the whole fruit, slice it, and place it in a steam-jacketed kettle or large preserving pan, taking care that it is either of copper or lined with enamel, the latter being preferable; place a little water over the fruit to prevent burning and slowly raise the heat to the boiling-point so that the juice of the fruit may be readily extracted, when it is strained off and filtered, so that it is quite clear. To every pint of juice now add 1 ℔. of best confectioners' sugar, place the whole in the preserving pan or steam-jacketed kettle and boil gently till a small portion jellies on cooling, when it is ready for putting up in glass or tins.

During the boiling the jelly should be carefully skimmed so as to remove any extraneous matter, as if this is neglected the jelly will not be clear. Absolute cleanliness in all the utensils and the use of nothing but the best sugar are the great secrets in making not only apple jelly, but also all other fruit jellies and jams.

In order to dispose of our fruit to the best advantage, there should be co-operation amongst fruit-growers. Attention must also be paid to the establishment of centrally located packing, curing, canning, and drying establishments, where the fruit will be properly graded and put to the use that it is best suited for; thus, fruit that is best adapted for the local fruit trade will be consumed fresh, that best adapted for export will be exported, that suitable for canning or drying will be canned or dried, and that suitable for pulp jam or jelly will be so utilised.

Such establishments should be adapted to the requirements of the district where they are erected, and should be worked, as far as possible, on co-operative lines. They will require to be run by thoroughly competent men, who must be experts in the business, and who will put up the fruit in the best possible manner. It is of the greatest importance that the quality of the output should be of the highest grade, and that this standard of excellence be maintained, as unless this is done the establishment will be a failure. Such establishments can handle the fruit cheaper, better, and much more expeditiously than private growers, and they have the advantage of being able to put up the fruit, whether fresh, dried, canned, or otherwise, of a uniform standard quality, and to maintain the standard—a matter of the greatest importance when selling the produce.

Every fruit-grower should put up all the fruit he requires for home consumption, as this is easily and inexpensively done, but the average fruit-grower is not advised to go in for canning or jam-making on an extensive scale, as it is felt the result will, in many cases, be very far from satisfactory; rather join together and get a really good man, who thoroughly understands the business, and who can turn out a first-class article. In conclusion, it may be said the secret of successful fruit-growing is thoroughness; nothing will pay to do ill that will not pay very much better for doing properly. Choose suitable soil; prepare the land properly; plant your trees well; plant nothing unless it will grow to perfection, and only plant few varieties. Look after your orchard thoroughly; cultivate it well; prune it well; thin heavy crops, and keep down all diseases, and when your orchard has come to bearing you will have good fruit, which, if carefully handled, well and honestly packed, will sell well in any market, no matter whether it is fresh, dried, canned, or otherwise. Fruit-growing conducted on these lines will pay well, but the days of growing rubbish at a profit are past.

INSECT AND FUNGUS DISEASES OF FRUIT-TREES AND THEIR REMEDIES.

COMPILED BY MESSRS. ALLEN, BLUNNO, FROGGATT, AND GUTHRIE.

THE APPLE-TREE.

A.—Insect Pests.

(1.) *Codlin moth* (Carpocapsa pomonella, Linn.).

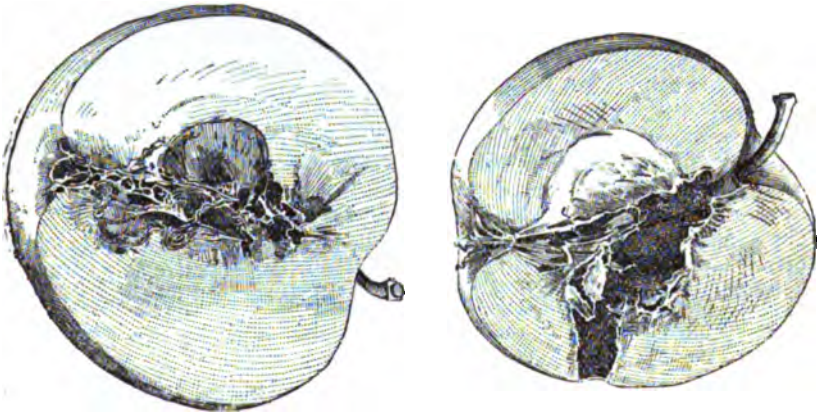
Description and Life History.

THIS moth is of a general greyish-brown colour, with the tips of the fore wings marked with several bronze or copper-coloured bands forming a rounded metallic-tinted patch, that gives it a very distinctive appearance. The usual habit of the moth in the daytime is to rest with its wings folded over its body, so that it is seldom seen by an orchardist, for its dull colour assimilates with the surrounding bark, while its small size, about half an inch in length when at rest, and not more than an inch across its outspread wings, enables it to escape detection.

The first brood of moths emerge just about the time when the apple-trees burst into bloom. They lay their eggs upon any part of the fruit or even foliage of the tree; but when the grubs emerge they, with few exceptions, crawl towards the calyx eye of the fruit before they commence to feed, sometimes feeding for a day or two in this cavity before they bore into the apple. The grubs growing with the fruit are fully developed when the apples are not more than a quarter grown; then they eat their way out through the side of the fruit, and if the apple does not fall during the process (which is frequently the case), the codlin moth grub spins a silken thread and lets itself down to the ground. It immediately crawls away and up the first tree trunk it comes across, forms a fine silken cocoon in the first suitable shelter it can find, and changes into the second or chrysalid state. If these chrysalids are left undisturbed, the moths (No. 2 brood) will breed out in from a week to ten days' time, the time depending much on the warmth and season of the year. These moths are not particular where they lay their eggs, nor are the freshly-hatched grubs so particular where they gnaw their way into the apple; and though many of them make for the calyx, others will enter through the side, where two apples are growing close together, or where a leaf is touching the fruit. With a dry, warm summer, a third brood, with exactly the same habits, attacks some of the late apples; the last, or winter, brood do not pupate like the former ones as soon as they find a crevice, but remain hidden through the winter in the grub form, only turning into chrysalids a week or two before they are ready to emerge with the bursting of the apple bloom.

Grub.

Moth.



Fruit attacked.

TREATMENT.

The destruction of the pest, now that we know its life-history, is simple. The first object is to destroy the young grubs before they enter the apple; and, failing this, to destroy all those that escape from the fruit before they can reach the moth stage. Each female moth is capable of laying up to eighty eggs, so that every pair of grubs killed means a great gain in fighting the succeeding generations.

(*a*) *Spraying.*

The first remedy is spraying with Paris green, and this should be done as soon as the petals fall from the calyx of the young fruit; for this is then open, and the poison lodges in the cavity. In most apples, and some pears, the sepals of the calyx close up over the cavity in about ten days' time, so that after this date it is too late to spray; and some of the latest authorities say that one spraying, if thoroughly done before the closing of the calyx (if no rain come in the interval, when it should be repeated), is quite sufficient to destroy the first brood.

Directions for preparing Paris Green for spraying.

Formula:—1 lb. Paris green.
1 lb. fresh-slacked lime.
180 gallons water.

Mix the Paris green with a little water, so as to make a paste, as if preparing mustard; strain, and add the lime; keep the whole well stirred up and thoroughly mixed all the time the sprayer is working. When smaller quantities are required, 1 oz. of Paris green to 10 gallons of water gives the requisite strength. Some people add a pint of treacle, or 3 lb. of soft soap, to the 180 gallons when spraying for vine-moth or other foliage-eating insects, as the Paris green then sticks better to the leaves; and either of these additions could be used when spraying pears for codlin moth, as in some species the calyx remains open much longer than in the apple.

The object of the spraying is to deposit the poison on the fruit, and particularly in the calyx, so that the young grubs eat it and die before they enter the fruit.

Paris green is excessively poisonous, and must be handled with caution. There are two, perhaps more, grades of Paris green in the market. One of these is mixed with sulphate of baryta, and is sold for use as a pigment. Be sure, therefore, to ask for pure Paris green for spraying purposes.

The addition of baryta can hardly be called an adulteration, as it is added to give "body" to the pigment; but it renders it less effective as a spray.

Sulphate of baryta is white, and can often be recognised by simply crushing any lumps present.

Tests for Paris Green.

Paris green is a light green powder. It contains copper and arsenic, and is an arsenite of copper. It does not dissolve in water, but when pure dissolves readily in any common acid, or in ammonia, with the latter forming the dark blue colour characteristic of salts of copper. When either acids or ammonia are used, any sulphate of baryta present can be at once detected, as it will remain undissolved in the form of a heavy white powder.

(*b*) *Bandaging.*

The second remedy for the destruction of codlin moth is bandaging, and this is done to trap the full-grown grubs that crawl up the tree trunk to find a place of safety in which to spin their cocoons. The bandage, if properly placed, fills a long-felt want to the grubs, and on finding it in their path they invariably pupate in its folds. A strip of old bagging, hessian, blanket, or such-like material, 12 to 16 inches in width, and long enough to go right round the tree trunk and overlap at the ends, is wrapped round the tree about a foot above the ground, and tightly tied round the centre with a string or rope, and the upper half of the band turned down over the lower half. Where the trees are very badly infested with grubs, it will be found advisable to put a second bandage round the trunk a foot above the other.

These bandages should be placed on every tree in the first week in November, and should be examined every week, all the grubs and pupæ killed, and then re-tied.

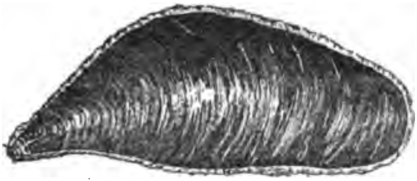
Windfalls should be always gathered up and destroyed. Where the trees are large, with much rough bark, they should be scraped in the winter with a blunt knife or piece of hoop-iron, so that the hiding-places of the grubs are still further reduced.

The whole of this treatment is very simple, and costs very little in money; yet, wherever it is carried out, it will give the orchardist 75 per cent. of clean apples where before he did not have 25 per cent., and this even in spite of dirty orchards close by, for the codlin moth is a weak flyer, and does not travel far in its perfect state.

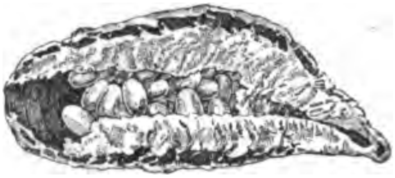
(2.) *Mussel Scale* (Mytilaspis pomorum, Bouché).

Description and Life History.

This is a very common pest in the apple orchards of New South Wales. When fully developed, the slender brown scales—not unlike a tiny mussel-shell—cover the remains of the dried-up female, and a cluster of semi-transparent eggs, which are ready to hatch and crawl out as soon as the warm weather sets in, will be found on turning over the scale. As with other scale insects, it is the countless numbers of these minute larvæ, each armed with a sharp-pointed tubular sucking mouth, that, stabbing the bark and feeding upon the sap, and afterwards spreading on to the leaves and fruit, rob the tree of a great deal of its life, causing the bark to be diseased, the foliage to discolour, and the fruit to become unsightly, or fall off before it ripens. Apple-trees badly infested with mussel scale



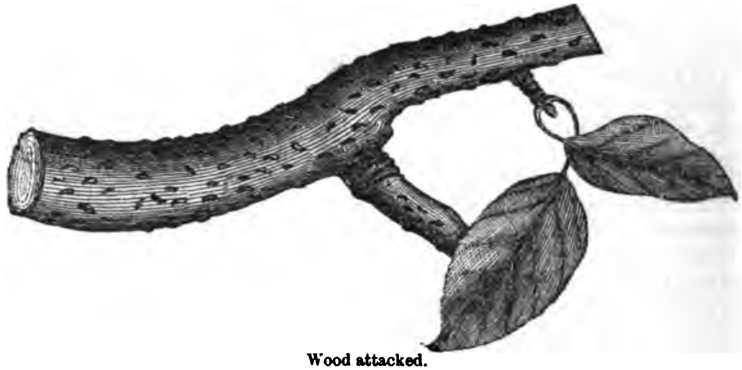
Mussel Scale, upper side, much enlarged.



Mussel Scale, under side, much enlarged.

Fruit attacked.

have the bark of the trunk and main branches apparently roughened, and when carefully examined it will be seen that this roughness is caused by the raised backs of this scale, often so close together that one could hardly put a knife point between them.



Wood attacked.

TREATMENT.

Experience has shown that the best time to fight this scale is in the winter months, when the foliage has fallen, and the life of the trees is dormant; and lime, sulphur, and salt wash is one of the best remedies to use.

Directions for making Lime, Sulphur, and Salt Wash.

Formula :—Lime, 30 lb. (fresh slacked).
Sulphur, 20 lb.
Salt, 15 lb.
Water, 60 gallons.

Take 10 lb. of lime and 20 lb. sulphur, and boil them until thoroughly dissolved, then add the rest of the lime and the salt and water to make 60 gallons. Strain and spray when rather more than milk-warm.

The only difficulty likely to be experienced in making up this mixture is in getting the sulphur thoroughly incorporated. To do this requires continuous boiling, with constant stirring, until the liquid is of a deep yellow colour. If it is feasible, the sulphur should be first ground up with a small quantity of water into a paste, in the same way that mustard is made, so that the grains of sulphur may be thoroughly wetted. This will greatly hasten the process, and if as much as 20 lb. of sulphur is to be used, this may be ground up a little at a time in a largish mortar and added to the boiling solution.

The best thing to use for boiling this mixture in is an enamelled vessel. If only a small quantity is made at a time, an ordinary enamelled preserving pan is the very best kind of vessel. In the absence of these, an iron vessel or an ordinary oil-drum may be used. On no account use copper vessels.

The actual manner in which the ingredients are added does not matter. It will be found best to slack the lime on a board in preference to slacking it in the vessels. Hot water is not necessary for slacking it.

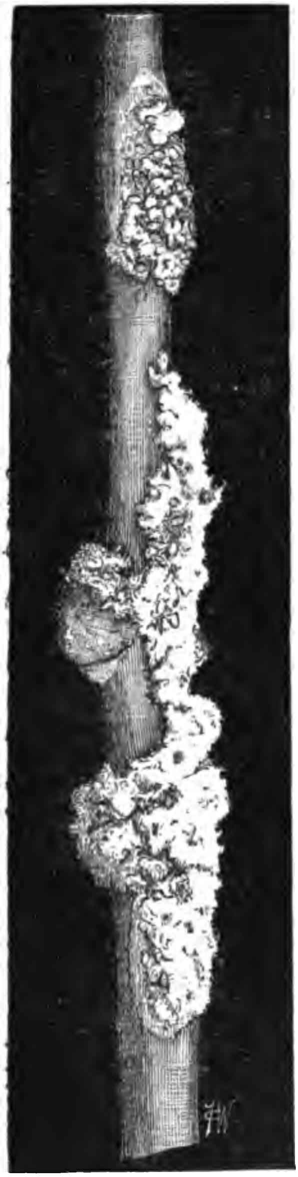
The main point is that the lime and sulphur should be well mixed and thoroughly boiled together.

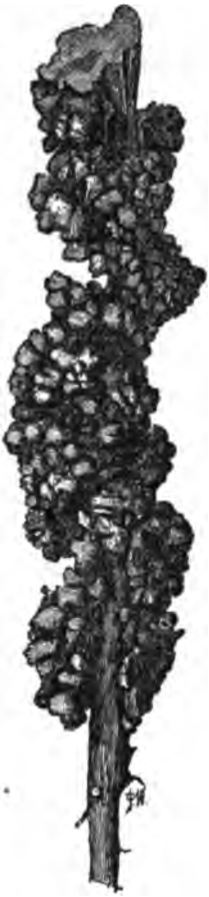
The action of this spray is to smother and destroy the scale and eggs. Some people scrub the bark of the trunk and main branches with a brush before spraying them with this wash.

(3.) *Woolly Aphis, or American Apple Blight* (Schizoneura lanigera, Hausman).

Description and Life History.

This pest is generally noticeable by the mass of white flocculent matter produced by the insects, which comes off on one's hands or clothes when touched; but this secretion only forms a protective covering to the small lead-coloured aphides that cluster together in numbers in each crack or crevice on the tree. They first appear on the roots, produced from eggs that have been deposited there by a former brood of females, and if unnoticed cause the roots to become gnarled and distorted into lumps. They then crawl up the tree, gradually getting all over it, take up their abode in any crack or hole in the bark, and by the irritation caused by their sharp-sucking mouths, cause unsightly excrescences to form on the bark, soon spoiling the tree.


Woolly Aphis.


Woolly Aphis.

TREATMENT.

The first consideration when planting young apple-trees in new ground is to plant only blight-proof stock, see that their roots are clean, and, to make more certain, it is advisable to dip their roots into a decoction of tobacco-water. But in nearly every old apple orchard the ground is more or less infested with the eggs or larvæ of woolly aphis. In an old orchard the best method to kill this pest is to start on the roots, and afterwards spray the tree.

(*a*) *Injection with Bisulphide of Carbon.*

Bisulphide of carbon is a volatile liquid with a very disagreeable smell, and very inflammable. It must therefore be kept in a cool place, well corked, and no light, sparks from pipes, &c., allowed to come near it.

Two injections of 1 oz. each into the ground 2 feet from the tree. After an interval of five days inject another 2 oz. in 10 yards square round the tree in doses of 5 grams per square yard. Of course, this treatment could only be carried out in large apple orchards, and a Vermorel Injector (as used in the treatment of vines infested with phylloxera) should be used to obtain the exact quantities.

(*b*) *Tobacco.*

Take 3 to 5 lb. of waste tobacco well dried and ground up, according to the size of the tree, and after throwing back the earth from round the trunk and removing 3 inches of soil for about 3 feet round the tree, spread the tobacco evenly over the exposed roots and round the main trunk. Then throw back the earth, and when the winter rains set in the poison is washed out of it, and destroys the aphis upon the roots, and keeps the survivors from coming up from below.

(*c*) *Killing upon Trunk and Branches.*

Spray the trees with strong tobacco wash or kerosene emulsion (hot) when the aphis first shows upon the branches.

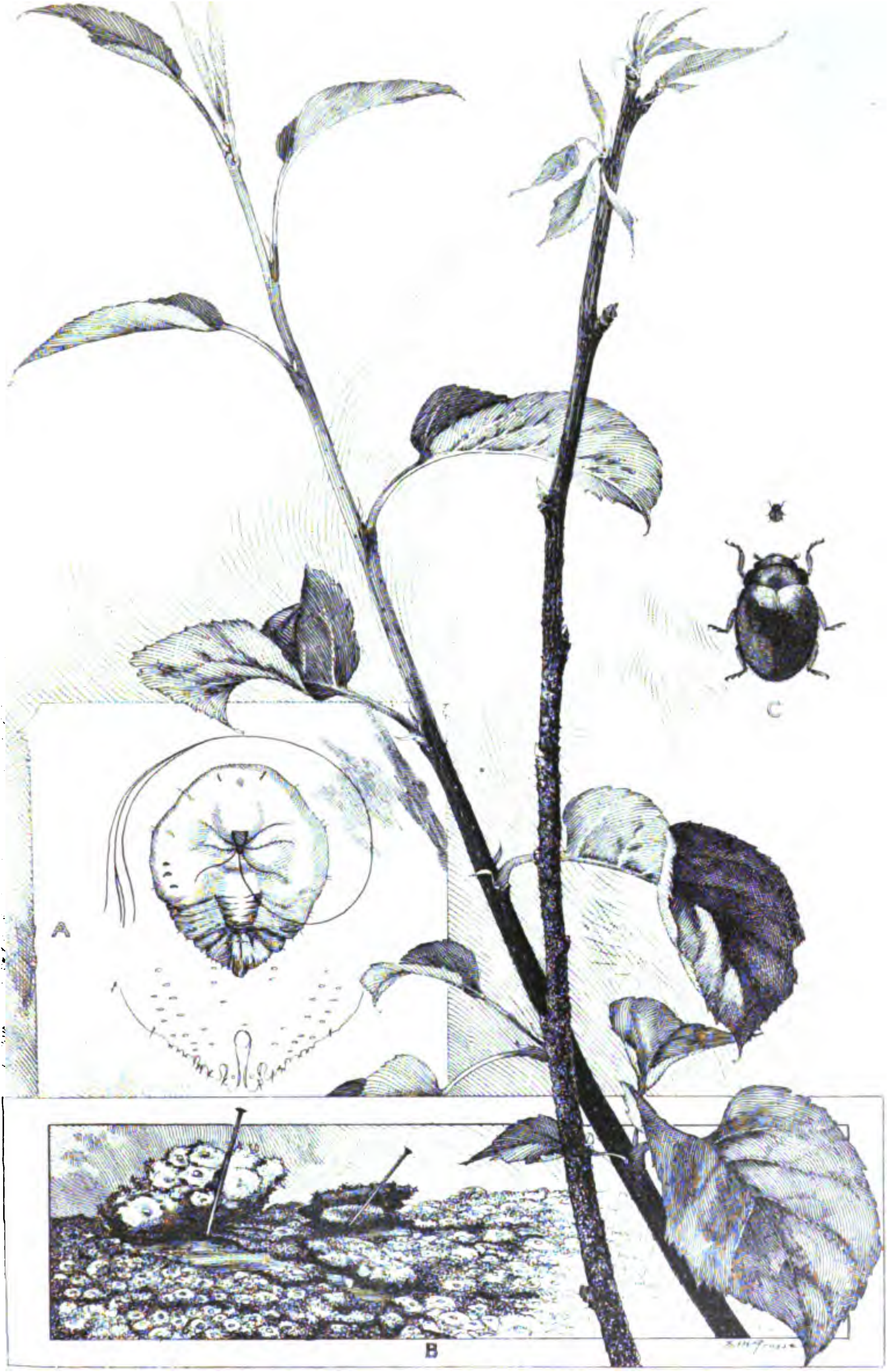
Tobacco-wash can be prepared by boiling up 2 lb. tobacco with 6 gallons water for about 20 minutes; 1 lb. of soft-soap may be added whilst the decoction is proceeding. When strained the mixture is ready for use.

For preparation of kerosene emulsion, see Pear-leaf Blister Mite, p. 345.

(4.) *San Jose Scale* (Aspidiotus perniciosus).

Description and Life History.

This scale in its earlier stages is one of the most difficult species to detect, because of its small size and the closeness with which it sticks to the bark. In January and February the small yellow larvæ are crawling about all over the tree, but are not visible to the naked eye until they settle down and form a white skin, not larger than a pin's point; as time goes on this increases in size (but the full-grown scale is only $\frac{1}{16}$ of an inch in diameter), and is perfectly round, black, with a yellow spot in the centre. A tree badly infested looks as though the bark had been covered with soot and ashes, and is quite scurfy; if this is rubbed off it will be seen that the bark is more or



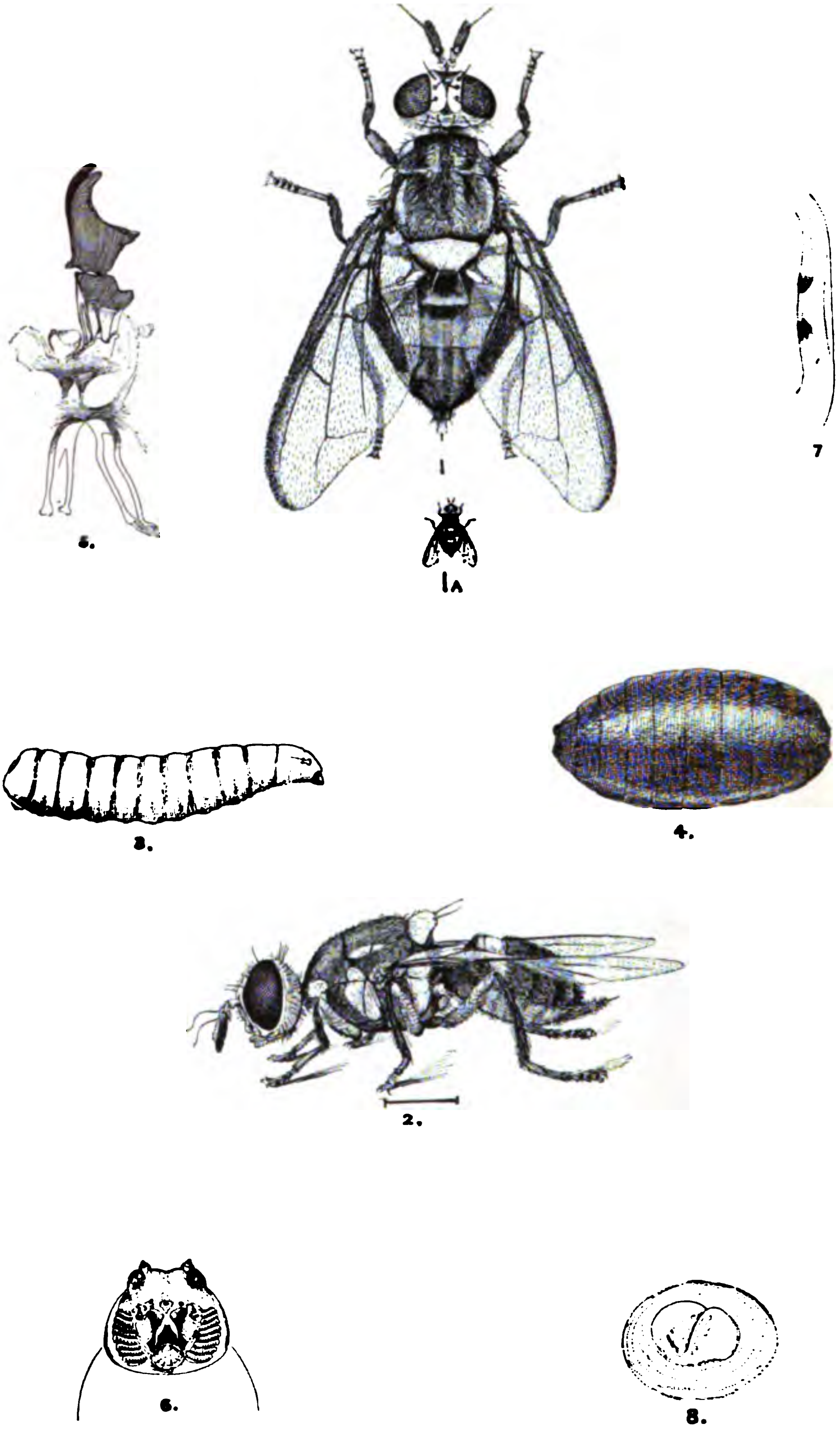
San Jose Scale (Aspidiotus perniciosus, Comst.).

A. Adult Female (much enlarged), after Howard. Adult Female, Anal Segment (highly magnified), after Howard.

B. Stem of Apple-tree thickly covered with Adult Female Scales (enlarged original).

C. Lady-bird Beetle (Rhizobius debelis, Blackb., enlarged), found feeding upon scale in orchard, Berowra, N.S.W.

D. 1. showing spray of Apple-tree clean, without Scale, as it appears at the present time.



FRUIT MAGGOT FLY (*Tephritis Tryoni*, Frogg).

1. Perfect Fly, viewed from above.
1a. Perfect Fly (natural size).
2. Perfect Fly, side view (much enlarged).
3. Larva (magnified 5 times).
4. Pupa (magnified 7 times).
5. Showing horny mouth-parts of Larva (magnified 88 times).
6. Mouth parts, viewed from beneath, Hooks (No. 5) showing in the centre (magnified 55 times)
7. Anal Segment (magnified 27 times).
8. Tubercle on under-surface of Anal Segment (magnified 50 times).

less corroded and stained with a rusty red. When badly attacked the young scale spreads into the foliage and fruit, producing a little carmine spot, of which they form the central dot, and when upon the fruit they generally form a ring round the eye of the apple, which gives it a very striking appearance. The scale is one of the most destructive pests known, and, when neglected, will in a few years destroy the trees attacked.

TREATMENT.

It has been found in America that the effects of different sprays vary considerably under different conditions of climate; and, while in the warmer districts of California the pest is checked with one spray, in the eastern states it is much more difficult to deal with. In this country it seems to take several years to make a start, but, when once established, spreads very rapidly.

Directions for making Resin-wash for both Summer and Winter Spraying.

Formula :—6 lb. caustic soda.
15 lb. resin.
3 pints fish oil.
10 gallons of water.

Boil the water, add the soda, grind up the resin and sprinkle in (as if making porridge), stirring well at the same time; then add the fish oil, and boil well until thoroughly mixed and of a rich brown colour.

When ready to use, add 10 gallons of water (hot or partly warm) to each gallon of mixture, making about 100 gallons of spray. This is best sprayed on pretty warm, and the spraying should be repeated after an interval of about three weeks.

(5.) *Fruit Maggot-Fly* (Tephritis Tryoni, Froggatt).

Description and Life History.

This insect pest causes a great deal of damage to apples and pears in the New England districts, and though it attacks a great number of other fruits, in the neighbourhood of Sydney it seems to chiefly confine its attention to peaches, nectarines and oranges.

The perfect fly is a small yellow-tinted insect, not as large as the common house fly, with a wasp-shaped body and drooping wings when resting; but as the fly is seldom seen in the orchards, a detailed description is unnecessary. The female is armed with a slender needle-like ovipositor with which she pierces the skin of the fruit and deposits from one to ten eggs. These eggs, on hatching, produce slender white maggots, narrowest at the head, broadest at the tip of the body; the mouth is armed with a pair of curious hooked jaws, and when taken out and laid upon a dry surface can jump or spring to a considerable distance after the manner of a cheese mite. The maggots always feed towards the centre of the fruit and soon cause the fruit to decay and fall to the ground; but, unlike the codlin moth, they do not leave the fruit as soon as it falls, but remain often until it is quite putrid, changing to chrysalids in the earth, from which a fresh brood will again issue in a few weeks if not destroyed. The last brood of maggots remain in the chrysalid state through the winter months and carry on the work of destruction into the following season. (See plate.)

TREATMENT.

It will at once be seen that spraying is useless to kill the maggots feeding beneath the skin of the fruit. The perfect fly does not require much food, and the chief aim of her life is to deposit her eggs in fruit upon which the young can exist. We must therefore try chiefly to protect the fresh crops by preventing the maggots reaching their perfect or fly state.

All fruit which is seen to have any signs of their presence, either upon the tree or the ground, should be collected and destroyed, either by boiling, burning, or burying in the ground. The first is to be recommended, for nearly every orchardist could use the boiled apples for feeding pigs, and there is no chance of anything escaping when once boiled. When the orchardist has some pigs, particularly young ones, he could not do better than turn them into the orchard, where they would not only eat up all the fallen fruit, but by rooting up the surface expose the chrysalis of the fly which either the weather or the insectivorous birds would have a much better chance of getting at. The practice of running pigs, though not generally to be recommended, has been tried with excellent results in some of the large apple orchards of New England, where this pest was very bad last year. Of course in many of the smaller orchards of mixed fruits pigs would do too much damage; but in these a careful grower would have little trouble in collecting and destroying all damaged fruit. Keeping fowls in the orchard is also recommended, and where fruit fly has been bad in the summer, fowls running over the ground during the winter will scratch up and destroy many chrysalids of this and other destructive insects, such as codlin moth grubs, which are never very deep beneath the surface of the ground, or are hidden under loose bark.

Where fruit fly is found every orchardist should do his utmost to destroy every maggot, both for his own and his neighbour's sake, for every pair that reach the fly state are able to destroy an amazing amount of fruit, and spread the pest all over the country.

(6.) *Apple-root Weevil* (Leptops Hopei).

Description and Life History.

The beetles are of a light-grey colour, but their wing cases are really dark-brown beneath a coat of light-grey scales; consequently as the season advances the outer scales rub off, and the beetles vary much in colour. The male beetle is not more than half an inch in length, whereas the female is often a third longer, with the body very much larger. They have the head produced into the usual elongated snout characteristic of the weevil, with the short-elbowed antennæ standing out on either side, and sharp-flattened teeth situated at the tip of the snout. Fortunately their wings are aborted and they cannot fly, so can only get on the trees by crawling.

The beetle lays her eggs (about forty in number) on a leaf, and with some gummy secretion turns the other half of the leaf over, and gums them together. The grubs soon hatch out and crawl down to the ground, gnawing furrows out of the roots of the trees, and finally pupating in one of these furrows in a loose cocoon formed of bits of gnawed wood.

The ravages of these grubs on the roots of the apple-trees in Victoria some years ago caused the death of a great number of trees, and this beetle is especially included in the injurious insects in the Vegetation Diseases Act in force in that colony.

Here it has not been found such a pest upon apple trees; but it is a serious trouble to vignerons, the perfect beetles eating out the bud of the vines just as they are bursting.

TREATMENT.

When a valuable tree is affected, it would pay to open out the ground as recommended for woolly aphis either with bi-sulphide of carbon or tobacco dust, as these grubs do not live in the interior of the roots but gnaw the outside.

In this Colony hand-picking has been found to be sufficient; and as the beetles cannot fly, in a well-kept orchard where the drooping branches of the trees do not touch the ground, small tin collars like inverted funnels have been used like codlin moth bandages round the trunks of the trees. The beetles, trying to climb up to feed and deposit their eggs upon the foliage, are stopped by this barrier, and are very easily collected without the trouble of hunting all over the tree.

(7.) *The Dry-apple Beetle* (Metadoticus pestilans, Olliff).

Description and Life History.

This is a curious little beetle, just described by Mr. C. French in Victoria as a destroyer of apples, and we have on several occasions received apples attacked by these pests in New South Wales.

They are short thick-set little creatures, hardly the third of an inch in length, with the thorax and head forming a broad angle in front, the eyes large, and the antennæ long, formed of a number of short joints, the terminal ones forming a swollen or club-like tip. When first bred out they are covered with a greyish tint; but as this bloom wears off they assume a much browner colour, the brown ridges upon the wing-covers standing out distinctly. The structure of their legs is very peculiar, the fore pair being very long, with the tarsal joints of the male very broad and flattened. Owing to the difference in the length of their legs they have a curious jerky way of walking, and can also jump in a remarkable manner.

They deposit their eggs upon the apples, the small white legless grubs feeding within the fruit, which gradually dries up and remains hanging upon the tree after the rest have fallen or been gathered.

The Government Entomologist has bred this beetle from the woody excrescences common upon the black wattle (*Acacia decurrens*)—which is probably their natural food—from which they have found their way to the apple-trees.

TREATMENT.

All the dead and dry apples remaining upon the trees after the foliage has fallen, and any left under the trees, should be collected and burnt, in order to destroy the enclosed larvæ.

(8.) *The Light-brown Apple-moth* (Cacæcia responsina—C. postvittana, Walk.).

This is another small moth, said by French to be very destructive to apples in Victoria, with similar habits to those of the codlin moth, so that the same remedies are effective.

The Entomologist is not personally acquainted with this moth as a pest, nor does he think it does much harm in this Colony. It is somewhat larger than the codlin moth, with much lighter-coloured wings.

(9.) *The Australian Silk-worm Moth* (Antheræa eucalypti, Scott).

Description and Life-History.

The caterpillars of this fine moth in their native state feed upon the foliage of various species of gum trees, but within the last few years the moth has taken to depositing its eggs upon the pepper trees growing in the gardens, and also upon the foliage of the apple trees, which the young caterpillars eat readily.

The eggs are generally laid upon the leaves in twos or threes, and the young caterpillars are dark coloured, but with successive moults change to the bright green colour of the full-grown larvæ. Each segment is encircled with reddish tubercles or spines that are tipped with blue, and are still further ornamented with a tuft of small yellow spines, the latter, however, hidden when at rest. They attain a length of 5 inches, yet in spite of their size are hard to find among the foliage. They pupate in December, spinning a hard brown silken cocoon, that is attached to a twig or branch of their food plant, the moth emerging in April. The moths vary considerably in colour from fawn to dark reddish brown, and measure from 4 to 5 inches across the wings, both pair of which are marked with handsome peacock-eyes, and the male has beautiful feather-like antennæ.

TREATMENT.

Upon small trees hand-picking would soon clear the trees, but where larger ones are attacked spraying would have to be resorted to, and a very effective one to poison the foliage would be 1 oz. of Paris green to 160 gallons of water, well mixed, and sprayed lightly over the trees.

(10.) *The Grey-streaked Moth* (Prodenia littoralis, Boivd.).

Description and Life History.

This moth deposits her eggs in clusters, covered with down from the tip of her body upon the under surface of the leaves.

The young grubs feeding upon the leaves completely cover it, and soon eat all the upper surface; but, as they increase in size, eat the whole of the leaf. They are dull olive green when full grown, and are known as "climbing cut-worms." They pupate in the loose soil beneath the tree and take from two to three weeks before the moths emerge from the chrysalids.

The moth is of a general greyish brown colour, with a number of silvery lines marbling the outer half; the hind wings are silvery-grey and semi-transparent, with the edges finely fringed.

TREATMENT.

If noticed at first, it is easy to destroy them when just commencing to devour the leaves; but later on they would have to be sprayed with Paris green, in the same proportions as the silk-worm moths.

B. Fungus Diseases.

(1.) *Powdery Mildew of the Apple* (Podosphæra Kunzei, Lev.).

Description and Life History.

This disease does a great deal of damage to young apple trees, especially seedlings, in nurseries, but is also not uncommon on trees several years old.

It is caused by a fungus growth upon the surface of the leaves and tender branchlets, in the form of a white felt, which gives rise to such a quantity of spores as to have suggested the name of "powdery mildew." This is sometimes called by orchardists "sunburn" or "fire blight," because the leaves often dry up in their latter stages.

TREATMENT.

Bordeaux mixture (for preparation see p. 340) or *ammonio-carbonate of copper.*

Directions for making Ammonio-carbonate of Copper.

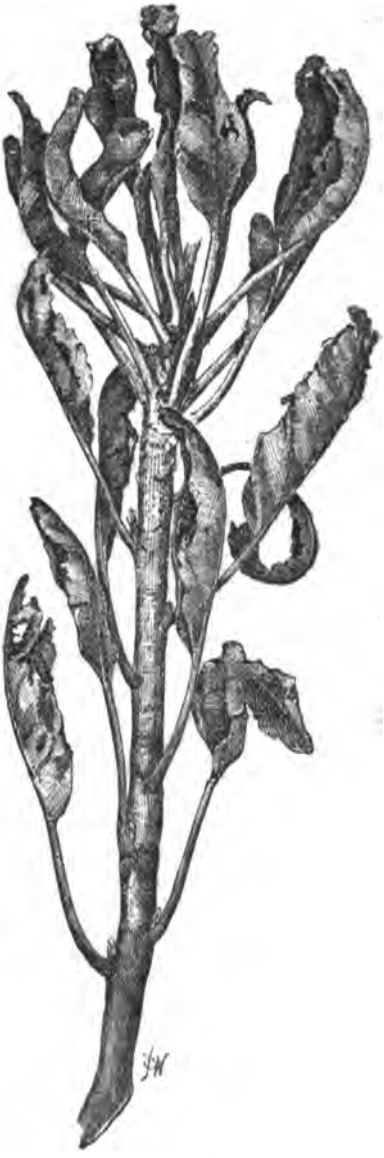
Formula—

Copper carbonate ...	5 oz.
Ammonia	3 pints.
Water	45 gallons.

Make a paste in a wooden bucket of the carbonate of copper and a little water. Add the ammonia, which will dissolve the paste, and then dilute to 45 gallons.

The first application should be made long before the leaves are half grown.

As this fungus belongs to the Erysiphea group, its *mycelium* spreads itself over the surface of the attacked organ, and resembles the oïdium of the vine, which also belongs to the same group. On this account, sulphur, which has been found so effective against oïdium, is equally effective against powdery mildew.



Powdery Mildew.

(2.) *Bitter Rot or Ripe Rot* (Glœosporium versicolor, B. & C.)

Description and Life History.

Some varieties of apples are much more subject to the attacks of this disease than others. It generally appears just about the time that the fruit begins to ripen.

The first symptom is the appearance somewhere on the surface of the apple of a small circular brown spot which rapidly enlarges and assumes various shades of brown, the different shades forming concentric rings which give it a very distinctive character.

Bitter Rot.

Within four or five days, when the spot has reached a diameter of about a quarter of an inch, the pustules burst and throw out a light salmon-coloured mass of spores. At this stage one spot may contain several hundred thousand spores, while as the disease develops they increase into millions, for the diseased spot keeps on throwing out rings of pustules until the whole apple is covered and rotten, the entire process requiring about a fortnight for completion.

This fungus can be easily propagated on other fruits, and Dr. Cobb has noticed it upon the peach, grape, pear, and orange.

The fact that the *Glœosporium versicolor* can also be propagated on grapes shows that if it is not the same as the *Glœosporium ampelophagum* (Sacc.) which causes the *black spot* of the vine grapes, it has many points in common with it. Both belong to the *Melanconiea* group.

TREATMENT.

As prevention, apply a winter dressing similar to that recommended against the *black spot* of the vine (see page 379).

Drain the ground if it is naturally too wet. For summer spraying use Bordeaux mixture (for preparation see under Apple Scab, p. 340) early in the period of vegetation, and keep the leaves and fruit well protected; but if fruits have been already attacked, apply a dressing of sulphur and air slaked lime in equal parts.

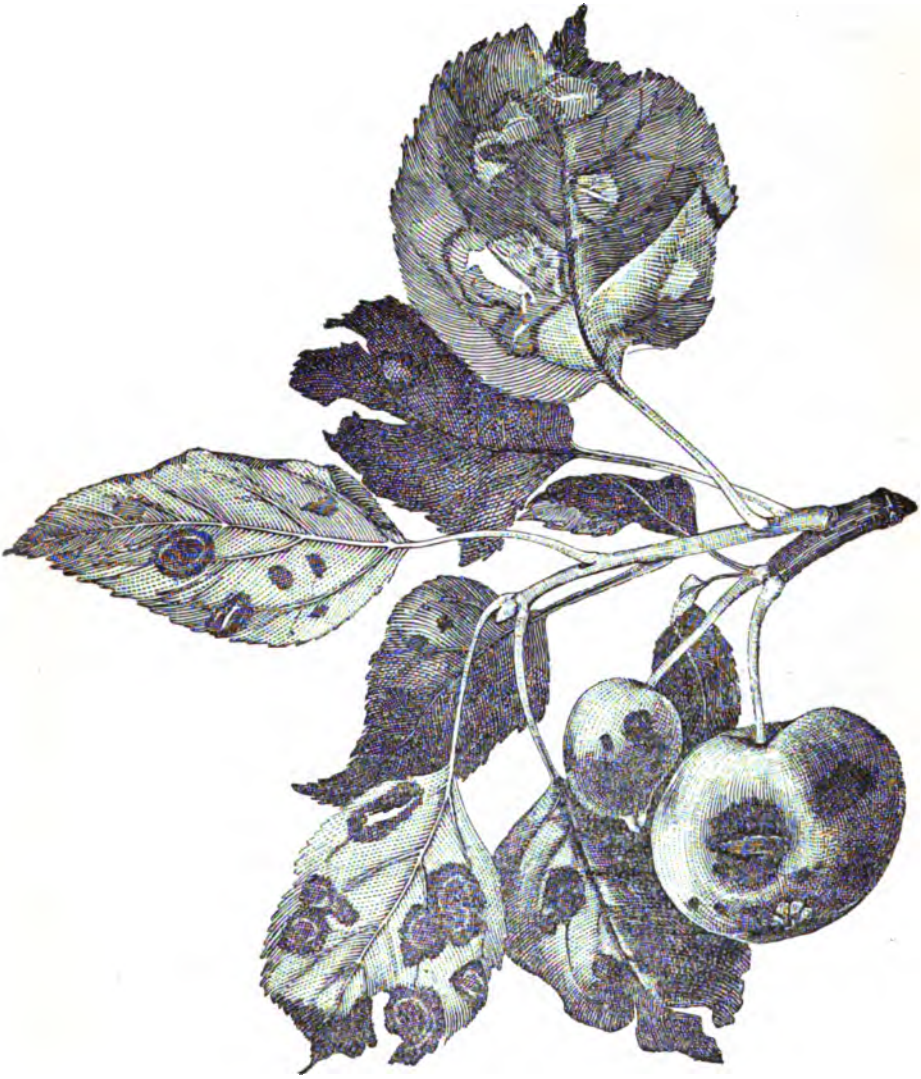
It takes the name of bitter rot from the taste that the disease gives to the affected apple.

All damaged fruit should be destroyed, for, if they are not, the next crop is sure to suffer from the spores generated upon the decaying fruit. Spray with ammonia-carbonate of copper (for preparation see p. 337).

(3.) *Apple Scab* "*Tasmanian Black Spot*" (Fusicladium dentriticum, Eckl.).

Description and Life History.

This is one of the commonest apple diseases, and does a great amount of damage to young fruit, particularly for about a month after the fruit has set.



Apple Scab.

Scab is easily recognised, forming dark or black-coloured scabs of various sizes, that soon spoil the look of the apple when growing, and cause an immense number to fall off altogether.

It is a fungoid disease, caused by the presence of spores known as *Fusicladium dentriticum,* and is closely allied, if not identical, with the fungus that causes pear-scab. The scars upon the fruit crack as the fruit increases in size. The leaves when young are often spotted with dark velvety green patches of the fungus, which afterwards dry up and cause the leaf to crack and break. The fungus attacks not only the fruit and leaves, but also the young wood, especially that of certain varieties. Here it may pass the winter, and thus be ready to attack the new leaves and fruit as soon as they appear.

TREATMENT.

Remedies.—Whenever practicable destroy affected leaves and fruit by fire or otherwise.

Spray with ammonio-carbonate of copper (for preparation see under Powdery Mildew, p. 337), or Bordeaux Mixture, as for pear-scab. Apply as soon as buds burst into leaf. Spray a second time when the leaves are about half grown. This should check it. Should the season be wet, sprayings should be applied oftener, so as to have the leaves and fruits always well protected.

Directions for Preparing Bordeaux Mixture.

Formula.—	Copper sulphate (bluestone)	6 lb.
	Lime	4 lb.

made up with 22 or 40 gallons water, according to the season, the smaller proportion being the winter dressing.

Copper Solution.

It is immaterial whether hot or cold water be used to dissolve the bluestone. If the mixture is to be made in a hurry it is best to boil the copper sulphate in water. If there is plenty of time use cold water; but in this case the bluestone must be suspended in a porous bag (bit of muslin or sacking) as near the surface of the water as possible. If the copper salt is thrown into the vessel, and water poured on top of it, it will not dissolve in a week. When suspended as described it should dissolve in about twenty-four hours.

The sulphate of copper solution when made must be diluted largely before the lime solution is added to it. This is a very important point. If the copper solution is too strong the precipitate formed is thick and heavy and liable to clog the nozzle of the spray-pump. If the copper solution is made by dissolving the bluestone in a small quantity of hot water it should be diluted to 20 gallons before adding the lime.

Lime.

The lime, which should be freshly burnt, is slacked with a small quantity of water. Slacking on a board is to be recommended rather than in a cask, because if the lime is really freshly burnt there will be considerable heat evolved, and the barrel may suffer. Place the whole of the lime on a board, and pour over it about 3 or 4 pints water. The lime, if it is good, should become very hot, crack asunder, give off a quantity of steam, and finally crumble into a fine, white powder. This is now emptied into a barrel and water added. It is not an easy matter to make the whole of the lime into a wash. It cannot be done by simply stirring about with a stick. The best way is to use a shallow tub, so that the lime may be pounded up with the water, all the lumps being broken up. Allow to settle, and pour off the milky solution through a strainer if any lumps are present (into the copper sulphate if you like, or into another barrel), and add more water, repeating the pounding until all the lumps have disappeared.

Mixing.

The mixture must be made by pouring the lime-water into the copper solution, and not by adding the copper solution to the lime-water.

The proportions of the Ingredients.

The proportions above given provide ample lime to more than neutralise all the copper sulphate; in fact, there is more than twice the quantity required to convert the copper into the hydrate, provided, firstly, that the lime is pure; secondly, that it is freshly burnt; and thirdly, that the lime is really all made into wash.

With regard to the latter point, instructions have never been given, and in many cases not more than quarter or half the quantity of lime recommended becomes finally combined with the copper.

If, in addition to this, the lime is not pure, and has been burnt some time before being used, it may quite easily happen that instead of the above quantities of lime being in excess of what is required, they may be altogether insufficient for the purpose, and that the solution may contain free copper sulphate. Assuming that free copper sulphate, even in small quantities, does "burn" the foliage, and that it is undesirable to have any in the mixture on this account, it appears preferable to have no fixed quantity of lime, but simply to have a definite quantity of copper, and to add the lime until the copper is neutralised. This is the plan recommended in the latest Bulletins of the United States Department, and is described in detail by Dr. Cobb in his *Letters on the Diseases of Plants.*

In order to know when the copper sulphate is destroyed, the readiest test is ferrocyanide of potassium; but it is important to remember that at a certain point ferrocyanide ceases to give the characteristic colouration (in such a solution as we are dealing with), although there is still unaltered copper sulphate in solution. In other words, the solution may contain free sulphate of copper, although the ferrocyanide test, applied as directed, does not show it. Therefore it is important to remember that the mixture is not ready for use when ferrocyanide no longer gives a red colour, but that a quantity more lime (even half as much again) must be added.

Instead of ferrocyanide, a rough test to show when sufficient lime has been added consists in placing a clean knife-blade in the mixture for a few minutes. If there is no red stain on the knife-blade the copper solution is neutralised; when this point is reached, add more lime.

Vessels Employed.

For the copper solution wooden vessels are preferable, though copper vessels may be used. Iron vessels should be avoided. For the lime, wooden tubs or barrels. Do not leave the mixture in the spray-pump, as it will slowly attack the copper; but when the spraying is finished, pour it away and wash the pump and hose well with water.

Purity of Ingredients.

Samples of "bluestone" are often received which contain a quantity of sulphate of iron. This adulteration can only be effected by dissolving copper sulphate and sulphate of iron, mixing the solutions, and allowing them to crystallise out. Such a method is much too elaborate to be carried out on a small scale, and there must be more of the stuff about. The following hints will enable anyone to suspect such a compound. Bluestone should be in the form of dark-blue crystals (the adulterated mixture referred to is light-blue, like sulphate of iron). They dissolve completely in water—readily and completely in hot water or water to which any acid is added.

In order to test its purity still further, add ammonia. A pale-blue precipitate is formed, which dissolves to an intense blue colour. This solution should be perfectly clear, and leave no sediment on standing. If a reddish sediment settles, it is due to the presence of iron.

Lime.—The best freshly-burnt stone-lime only should be used. To test it, place a few lumps in a small heap and sprinkle with water. The water should be absorbed by the lime, which gradually falls to pieces, becoming very hot in the process, and giving off a quantity of steam. It gradually crumbles to a fine white powder. If it does not get hot enough to give off steam, it has not been freshly burnt.

(4.) *Canker.*

Description and Life History.

This common and wide-spread disease, occurring on the bark and on the tissues under the bark of fruit trees, is well known in New South Wales upon apple-trees.

The first cause is generally traced to some external injury to the bark which is attacked by fungoid agents which increase the "sore" faster than the bark can produce "healing tissue," and causes the diseased area to spread rapidly, so that very often large limbs die back.

Prune off or cut out the worst branches, making a pretty deep incision, and covering the wound with grafting wax. Burn all the cuttings.

Whitewash is a good substance to apply to destroy the spores, and can be economically applied with a spray pump and a coarse Nixon nozzle. Winter spraying with Bordeaux mixture will also help to check it.

For dressing wounds made by the cutting away of the worst branches use also strong Bordeaux mixture, or a solution of sulphate of copper (5 lb. to the gallon of water), or a solution of sulphuric acid (1 pint to the gallon of water). Such solutions will cauterise the wounds and expedite the formation of healing tissues.

(5.) *Mouldy-core.*

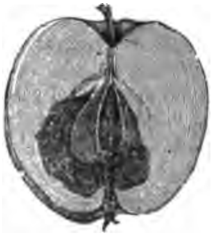
Description and Life History.

A diseased condition caused by the presence of common mould in the core of certain varieties of apples. Outwardly the apples often appear to be quite sound, but on cutting them the core will be found to be mouldy and half rotten. The way in which the mould gains an entrance is through spores adhering to the blossom end, where they germinate and then send their long threads through the aperture into the core.

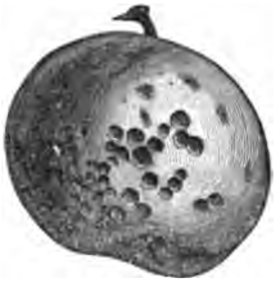
From this it is evident that it is advisable to discard all varieties that have open passages from this end towards the core, when growing keeping apples.

TREATMENT.

Spray with ammonio-carbonate of copper—(for preparation, *see* Powdery Mildew, p. 337)—commencing just before the fruit begins to ripen, and spraying about three times at intervals of about a fortnight.



Mouldy Core.



Bitter Pit.

Bitter Pit.

This disease appears in the form of small sunken brown pits having a bitter taste. This is probably a fungoid disease, though Dr. Cobb, who says he has known the disease for upwards of twenty years, remarks: "I have seen no evidence that would prove the disease to be caused by a fungus. No remedy can be proposed beyond avoidance of the sorts liable to the disease. Good keeping apples, as a rule, are not attacked. If a tree showed this disease badly two seasons in succession, I would advise removing it, for according to my observations the disease continues from year to year in the same tree. The disease seems to me like one connected with the wood, and not very contagious. The young spots on red and yellow apples are hard, green, and sunken. Apples attacked by bitter pit have poor flavour, and do not keep well."

THE PEAR TREE.

A.—Insect Pests.

(1.) *Pear and Cherry Slug* (Selandria cerasi).

Description and Life History.

This is a small black saw-fly, measuring about a third of an inch in length, with two pairs of transparent wings, short antennæ, and short thick-set body, which is furnished in the females with a fine saw-like appendage (from which this group of wasps take their popular name) with which it cuts a slit in the leaf and deposits from a dozen to eighteen eggs beneath the epidermis. In a few days the small legless olive-green slug-like grubs emerge, and commence to feed upon the upper surface of the leaf, which they soon destroy; when fully grown they measure half-an-inch in length, and have a rounded oval head and thorax, with the body much more slender, and cover themselves with a dark olive secretion that gives them a very slimy slug-like appearance.

They pupate in the soil beneath the tree, when full-grown forming a stout chrysalid, the perfect saw-flies emerging in about six weeks' time.

Pear and Cherry Slug.

This is a pest introduced from America, where it does a great deal of damage to pear, cherry, and other foliage in its larval state. It is also regarded as a very serious pest in Victoria, but in this Colony does not do very much damage, and is easily destroyed.

It is very partial to the hawthorn, and when hawthorn hedges exist it spreads rapidly.

TREATMENT.

Spraying with Paris green, 1 oz. to 200 gallons of water, will poison the foliage and not hurt the fruit (for preparation of Paris green, *see* Codlin Moth, p.).

Dusting the foliage with lime is one of the cheapest and best remedies, as the lime sticks to the slimy coat of the grubs and soon destroys them. Where they are found to be very destructive to the foliage it would be advisable to disturb the soil round the trunk of the trees, or treat them with lime, so as to destroy the cocoons in the ground.

(2.) *Cherry-tree Borer* (Cryptophasa unipunctata, Don.).

Description and Life History.

The moth in its native state attacks several scrub trees, but within recent years has taken to a number of introduced trees such as willows, cork elms, cherry, and pear trees.

The moth is a stout thick set moth about 2¼ inches across the wings, which are of a beautiful satin white colour with a single dark spot in the centre of forewings; legs and body yellow. The eggs are laid upon the bark of the tree; the young grubs, slender white creatures with reddish brown heads, gnaw off the surface of the bark, matting it together in a silken web, beneath which they bore a hole into the branch in which they can hide, often gnawing a ring right round the branch covered with this felted web.

As they increase in size this web becomes quite a thick mass, and the burrow below becomes enlarged, generally ending in the branch, snapping off in the first storm.

TREATMENT.

When a tree is found to be attacked by these grubs, remove all the felted web, and insert a bit of copper wire into the burrow so as to injure the grub; but as this cannot always be managed, it is also advisable to squirt a little kerosene oil into the hole, and then plug it up. Some growers have found that dipping a wooden plug in kerosene and then driving it into the hole, killed the grub.

(3.) *Pear-leaf Blister Mite* (Phytophus pyri, Scheuton).

Description and Life History.

This remarkable little mite is hardly visible to the naked eye, but the galls it produces on the under-surface of the leaves are generally rounded, measuring under one-eighth of an inch in diameter, but where the foliage is badly infected, coalescing and forming a bigger blotch. These galls always have an opening about the centre on the under side, so that the mites can escape on to the buds before the leaves fall. This is a very curious, elongated, cylindrical creature, with only two pairs of legs, head tapering in front, and transparent in colour. Opinions vary as to the amount of damage that these mites do to the trees they infest, but there is no doubt that they render the leaves very unsightly, and, by causing them to fall before their time, denude the tree so that the sun will affect it, and when the galls are abundant the crop of fruit will be reduced. It has been probably introduced into the country on nursery stock, but as far as is known, is not so plentiful or destructive here as in Victoria and America.

TREATMENT.

Kerosene emulsion is the most effective remedy against this pest, and should be sprayed on to the infested trees before the leaves burst out. When mixed with three parts of water, the State Entomologist in California (Mr. Alexander Craw) found that the trees were practically free from the galls, but when sponged with a mixture of eight parts of water, some galls still came out on the foliage.

Directions for preparing Kerosene Emulsion.

Formula :—Hard soap, ½ lb.
Kerosene, 2 gallons.
Boiling Soft Water, 1 gallon.

Dissolve ½ lb. of hard soap in 1 gallon of boiling water, after which the vessel is removed from the neighbourhood of the fire, the kerosene is added, and the two churned for ten minutes. One essential condition of success in making this emulsion is that the liquids should be as warm as possible. It is also necessary that the water be as soft as possible. For winter spraying dilute in 22 gallons of warm water.

In preparing this compound the main trouble is in getting a true emulsion, which can only be done by thorough agitation. This is best done by pumping the mixture into itself for some minutes. When this creamy mixture becomes cold it gets thick and almost solid, and there should be no trace of free oil on the surface.

If there is still unemulsified oil, the best plan is to add some more boiling soap solution and pump again.

Free oil destroys the foliage. Be sure and get the best kerosene and good soap.

Kerosene being highly inflammable, pay particular attention to the directions for doing the mixing well away from the fire. Boil the soap and water in one vessel, and carry it away from the fire before mixing with the kerosene. Any kind of vessel may be used.

Kerosene attacks india-rubber; consequently the tubing, and indeed the whole spraying outfit, must be well washed with hot water directly after use.

Sometimes it is of advantage to prepare a quantity of emulsion as a stock-quantity. When this is done, and it is required to dilute it to make up a spray, this should be done by adding boiling water to it, and not by melting it over the fire, which is dangerous, especially indoors.

(4.) *The Red Mite* (Bryobia pratensis, Garman).

Description and Life History.

From April to early summer a reddish tint will be frequently noticed upon the bark of both apple and pear trees, but chiefly the latter; sometimes, when the trees are badly infested, even the stakes are thickly covered. Upon examination with a lens it will be found that this is caused by countless numbers of tiny round crimson eggs, clustered together in every curve or irregularity in the bark.

Later on, when the buds burst out into leaf, these little creatures hatch, leaving an empty white shell behind, attack the leaves from the underside, sucking up the juice of the tree, and causing them to become mottled and fall off prematurely.

This mite is about twice the size of the "red spider," of a bright red colour, with four pairs of legs, the front pair much longer than the hind ones.

Heavy rains seem to destroy great numbers, and though this pest is so common and numerous in many orchards in some parts of the Colony, it does not seem to make much headway or damage in this country, yet in some parts of America it is looked upon as very destructive to fruit trees.

TREATMENT.

Remedies—Lime, salt, and sulphur wash. (For preparation and method of using, *see* Mussel Scale of Apple, p. 330).

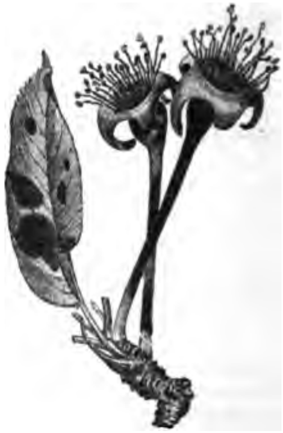
B.—Fungus Diseases.

(1.) *Pear Scab*, *Windsor Pear Blight* (Fusicladium pyrinum. Fckl.).

Description and Life History.

This fungus makes its appearance early in the season in the shape of velvety dark green spots or patches upon the leaves, fruit, and even the young wood. Later in the season these spots become converted into grayish or brownish cracked scabs. If the fungus occurs upon the flower-stalks or young fruit the result is disastrous; the fruit falls as soon as it is set. If the fungus does not attack the pear until half-grown, the fruit may be symmetrical, but the surface will be covered with unsightly scabs.

Both the *Fusicladium pyrinum* and *dendriticum*, attacking respectively the pear and apple trees, and causing the so-called scab, possess winter forms (*sclerotia*), which are hidden within the bark of the tree, and reproduce the disease from one year to another.



Pear Scab.

TREATMENT.

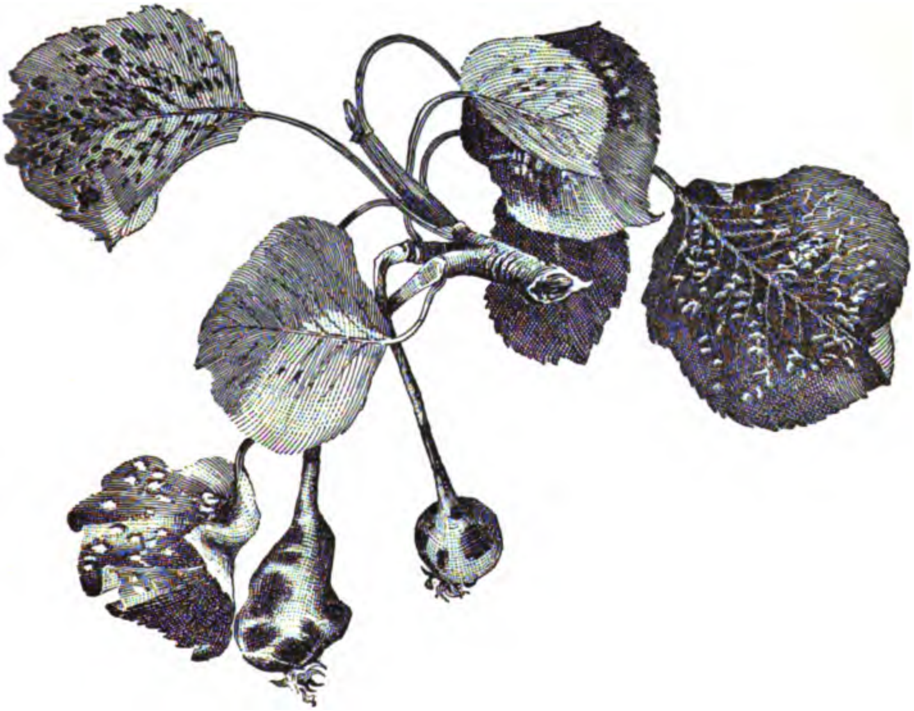
Winter dressing.

A winter dressing is absolutely necessary to prevent infection starting in spring, and is to be applied a few days only before the tree bursts into leaf.

Strong Bordeaux mixture, made with 8 ℔. of sulphate of copper and the same quantity of slacked lime for every 20 gallons of water, is a reliable winter dressing. To make it more effective, 5 oz. of ammonium chloride may be added.

Summer dressing.

As soon as the tree is in blossom apply the first spraying of Bordeaux mixture; this time, however, the proportion of the ingredients should be reduced to 2 ℔. sulphate of copper, 2 ℔. of slacked lime, for 20 gallons of water.



Pear Scab.

Keep the leaves and fruit always well protected with the mixture; but should the weather be very favourable to the development of the fungus, and should black spots show themselves on the small fruits, apply the Bordeaux mixture again, and make it stronger. One may go as far as 4 ℔. of sulphate of copper and 4 of slacked lime for 20 gallons of water. From 3 to 4 oz. of ammonium chloride may also be added.

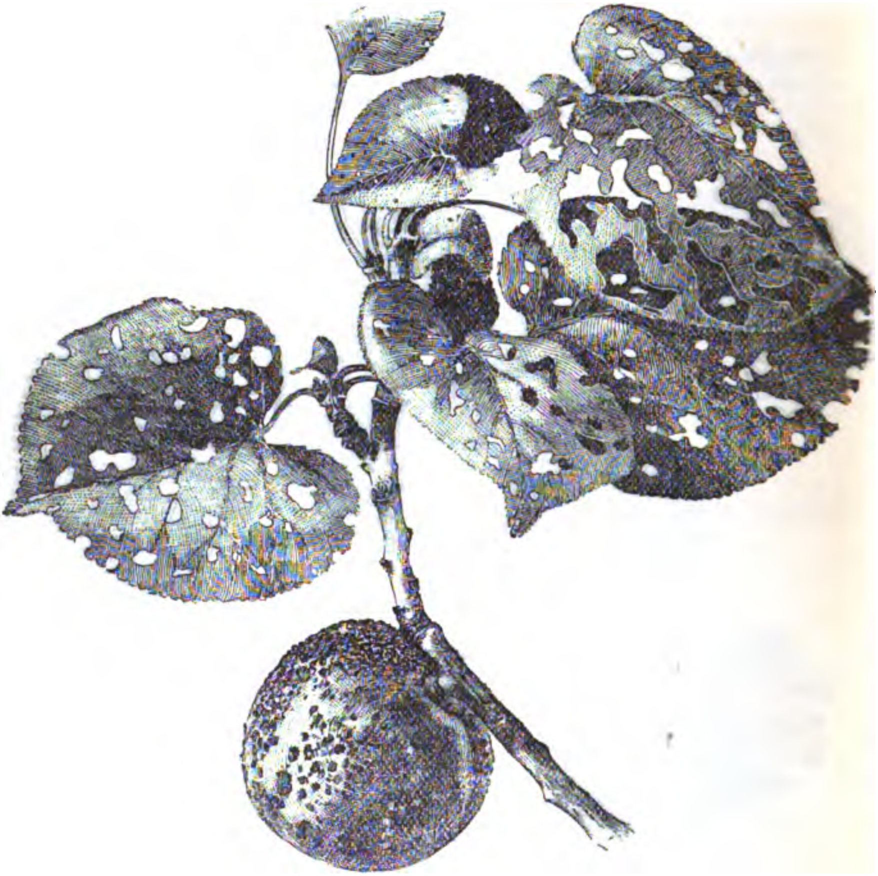
Other pests shared in common with the apple are—

Codlin moth.
San Jose scale.
Fruit-fly maggot.
Mussel scale.

The Apricot Tree..

Shot-hole Fungus (Phyllosticta circumcissa).

A very common disease upon the apricot, and sometimes also attacking the peach. The spores of the fungus cause the tissue of the leaves to dry out in little circular spots, so that a tree attacked looks as if the foliage has been riddled with shot.



Shot-hole fungus on leaves and fruit of apricot.

Whenever the leaves are badly affected the fruit seldom escapes, one side becoming scabby, and if infested at an early stage of growth becomes stunted and checked, and the fruit is rendered useless.

TREATMENT.

Shot-hole fungus is very effectually treated by means of spraying the trees affected with Bordeaux mixture. To apply Bordeaux mixture use a powerful spray pump with a Nixon or Vermorel nozzle that will not choke, and be careful to reach every part of the tree. If the disease is very bad, it is a good plan to give the tree two sprayings; one about half an hour after the first, as by this means you will get a very much larger amount of the mixture to stick on the tree, and there will be little chance of any part of the tree being missed. The best times to spray for shot-hole fungus are—first, as soon as the leaves fall in autumn, and then again when the buds are bursting in spring, and a third time when the fruit is just set. If properly carried out, these sprayings will practically exterminate the disease, or at any rate keep it in check to such an extent that there will be little, if any, loss. All mosses, lichens, or other vegetable parasitic growths on the trees are destroyed by the Bordeaux mixture, as are also the spores of any other fungi that would cause damage, either to the fruit or foliage.

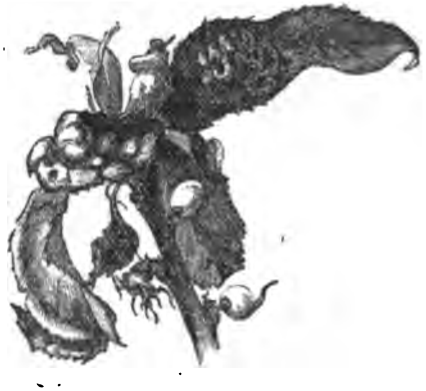
Gumming.

This is often a serious disease of the apricot, and one that is usually easier to prevent than cure. Badly-drained land, unsuitable situations, unsuitable stakes, improper pruning, and external injury to the tree are all liable to cause gumming, and they should, therefore, be provided against. In pruning never leave any narrow angles or forks, but let every limb have a fair hold; narrow forks check the flow of the sap, and so cause the tree to gum. A blow from a harrow, swingle-bar, plough, hoe, or other tool or implement will sometimes cause gumming, which, however, can be prevented if the bark is cut clean away from the bruise, and the bruise is covered with cow-dung and clay, or other material that will keep the air from the wound. Wherever gum appears cut away the diseased part till sound wood is found, covering the wound as just described. A longitudinal cut along the main branches and trunk of the tree will often be of value, as it seems to relieve the tree of surplus sap and allow it to make a healthy growth. As gumming is seldom present to any extent in the soils and districts that are best suited to the growth of the apricot, the best of all remedies is to only grow the apricot under such conditions.

The apricot is not much subject to the attack of insect pests. If troubled with scale, use the remedies recommended for scale insects on apples, or if the foliage is being eaten by beetles, caterpillars, or grasshoppers use Paris green.

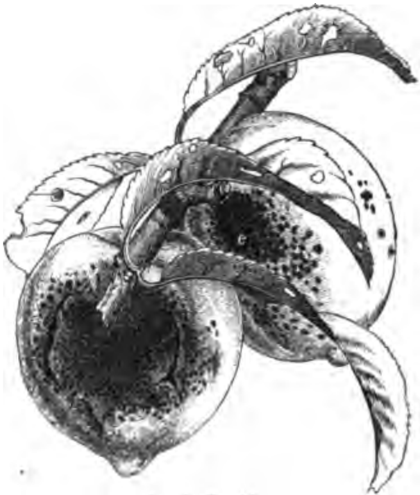
Peaches and Nectarines, Plums and Almonds.

Curl Leaf.—Spraying with Bordeaux mixture in winter and early spring.



Curl Leaf.

Peach Freckle.—Spraying with Bordeaux mixture in winter and spring.



Peach Freckle.

Rust.—Spraying with Bordeaux mixture in winter. The application of sulphate of iron as a manure.

Scale Insects.—Same remedies as advised for apples.

Gumming.—Same remedies as in the case of apricots.

Peach Aphis (Aphis persicæ-niger, Smith).

This is one of the most serious pests that the peach-grower has to deal with in the spring, when the trees are just coming into leaf, and if neglected may cause the loss of all his crop, the young branchlets becoming curled and twisted from its attacks, while many of the nursery seedlings and stocks are frequently killed.

It is common all over the colonies, and was very severely felt last season in many parts of New South Wales.

These insects are almost too well known to need description. They are of a dark-brown to nearly black colour when adult, smooth and shining. The young ones are lighter coloured, with the eyes and nectaries black. Some of the females are winged, and they all cluster together round the buds and young shoots of the plant.

They winter upon the roots of the trees, crawling up in spring, but even as early as July some will be found on the underside of the lower branches and suckers. They feed in the same manner as the scale insects, piercing the bark with their sharp tubular mouths, and sucking up the sap of the tree, multiplying with such rapidity that by the time the leaf-buds and flowers burst out, they look as if they had been dusted with lamp-black, and if neglected at this time cause the young fruit to fall.

Last year, in the Ryde and Parramatta districts, where this pest had been neglected, the orchards looked as if they had been scorched with a hot wind, but where they had been sprayed in time the crop was saved, and the foliage of a normal green colour.

TREATMENT.

The first plan to check the aphis is to attack the winter broods upon the roots, which can be treated with waste tobacco in the same manner as the American blight upon the apple-trees.

Watch the trees, and as soon as the first winter broods of aphis are found upon the lower branches, cut off the affected buds and burn them, with all suckers.

Spraying.—(1) *Tobacco Wash.*

Directions for making Tobacco Wash.

Formula:—Tobacco, 2 lb.
Soft soap, 1 lb.
Water, 6 gallons.

Boil the tobacco in a bucket, and let it stand overnight. Strain it in the morning, adding the soft soap and more water. Spray on warm. Two or three applications if the aphis still appear. The nicotine of the tobacco kills the aphis, the soap assisting to make it penetrate and stick. This wash will not injure the most delicate foliage upon the young peaches.

(2) *Resin Wash.*—See page 333.

The Fig-tree.

Fig Beetle.—Spraying with Paris green.

Black spot of the Fig.—Spraying with Bordeaux mixture in winter and spring.

The Olive-tree.

Thrips.—Spray with resin and soda wash.

Scale insects.—Spray with kerosene emulsion.

Strawberry Leaf Blight.

Spray with Bordeaux mixture.

Strawberry Leaf Blight.

Diseases of Citrus Fruits.

Red Scale.

The scales fasten to the bark, leaves, and fruit, feeding upon the sap, and are most easily destroyed when the larvæ are in motion. The first spraying may be done just as the buds are showing on the trees in spring, a second and third spraying about the beginning of December and latter part of January respectively, and a fourth about the middle of March.

Some growers prefer kerosene emulsion, while others consider resin wash the most satisfactory. The Fruit Expert is of opinion that either of these mixtures properly applied will be found quite effective in ridding the trees of scale.

Directions for preparing—

Kerosene Emulsion :—Hard soap, ½ lb.
Kerosene, 2 gallons.
Boiling soft water, 1 gallon.

Dissolve one half-pound of hard soap in 1 gallon of boiling water, after which the kerosene is added, and the two churned for ten minutes. One essential condition of success in making this emulsion is that the liquids should be as warm as possible when applied. It is also necessary that the water be as soft as possible.

Resin Wash :—

Caustic soda, 70 per cent.	6 lb.
Resin	16 lb.
Fish oil	3 pints.

Boil 10 gallons of water and add the above, boiling the whole together from two to three hours, or until well dissolved. Keep well stirred. Add hot water, a little occasionally until there is not less than 20 gallons of hot solution. Dilute in the proportion of 4 gallons of hot water to 1 gallon of the hot solution, or so as to bring the whole up to 100 gallons. Never add cold water when cooking.

If the trees are smutty also they should receive a winter spraying of kerosene emulsion (diluted in 22 gallons of warm water).

The treatment for white scale (white louse), mussel scale, and glover scale is practically the same as for the red scale.

Thorough cultivation and liberal application of suitable fertilisers should go hand-in-hand with spraying.

Melanose.

This disease (says Dr. Cobb[*]) is known to our orchardists, in the county of Cumberland at least, as Orange Rust, and occasionally as Maori. I think both these names should be abandoned in favour of Melanose. The disease is in no sense a "rust," the name of "rust" being one that should be reserved for those diseases caused by fungi related to the well-known wheat-rust. Maori is a name already in use for a distinct disease of the orange, concerning which I will here only remark, that it sometimes resembles Melanose in a very marked degree, a fact that is sometimes very puzzling to orchardists, especially as the two diseases often occur on the same orange, as shown in one of my photographs on page 353.

There is no doubt that Melanose is doing much damage. Even where the tree is not prevented by the disease from bearing a crop of fruit, the surface of the fruit is so disfigured by the multitude of small dark spots as to have its market value seriously diminished.

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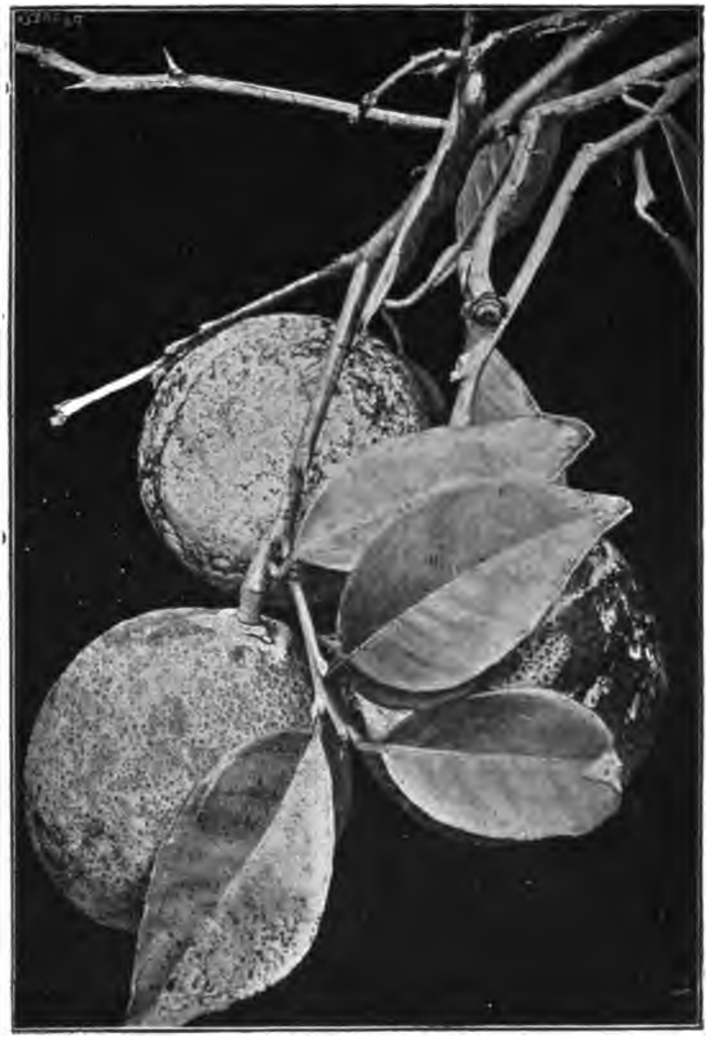
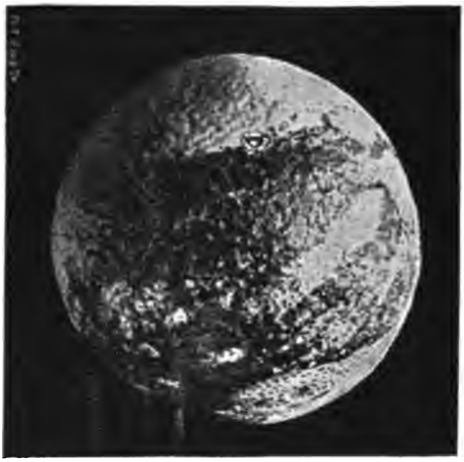
[*] *Letters on Diseases of Plants*, April, 1897.



The disease Melanose as it appears on the fruit and leaves of orange-trees at Pennant Hills, about 10 miles from Sydney, N.S.W. The two left hand oranges show the disease without any complications, the upper one more especially showing the arrangement of the small diseased spots in archipelago-like groups, while the lower shows a more advanced stage of the disease in which the spots have run together (lower left-hand part), or have developed a distinct mycelium at the edges (upper right-hand part). The right-hand orange shows the disease Maori as well as Melanose, this latter disease appearing somewhat in the shadow of the leaves, while the Maori is most conspicuous on the extreme right. All the leaves show Melanose, but it is most marked on the lowest leaf. The bark of the young twigs is also slightly attacked. As this photograph was taken in the orchard from perfectly fresh material the effect is very faithful and life-like.

Many trees are now suffering so much from Melanose that the crops are diminishing; and I have seen trees in a dying condition, that seemed to be suffering principally from this disease.

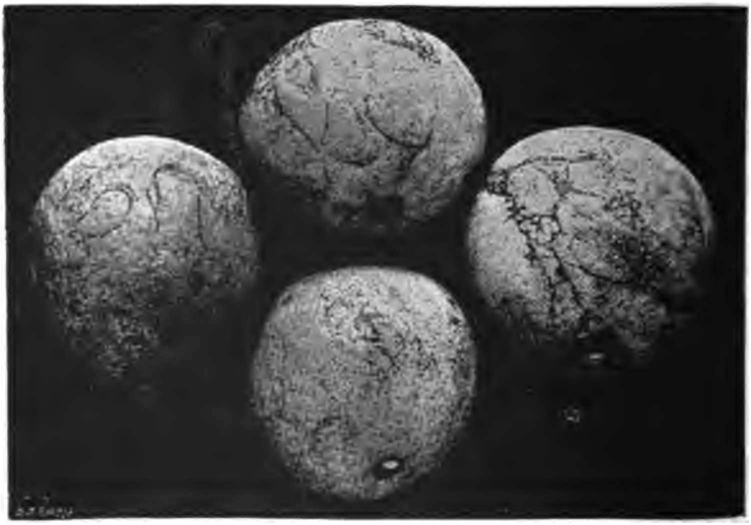


An orange affected with the disease known as Maori, showing the *continuous* nature of the brown colouration characteristic of this disease. The colouration does not in this case extend over the whole orange, though such is frequently the case.

REMEDIES.

1. Prune the trees rather severely, taking the precaution to remove the branches that show the most disease. Prune with an eye to spraying, that is, leave the tree so that every part will be accessible to the spraying machine nozzle. Burn the cuttings.

2. Begin as soon as the fruit has set, and spray with Bordeaux mixture, of one-half the usual strength, once every ten days or two weeks, until about a month before the fruit ripens. The Bordeaux should contain only 3 lb. of copper sulphate to 40 gallons of water, or it may even be more diluted than this. Bordeaux mixture of the usual strength sometimes injures orange trees.

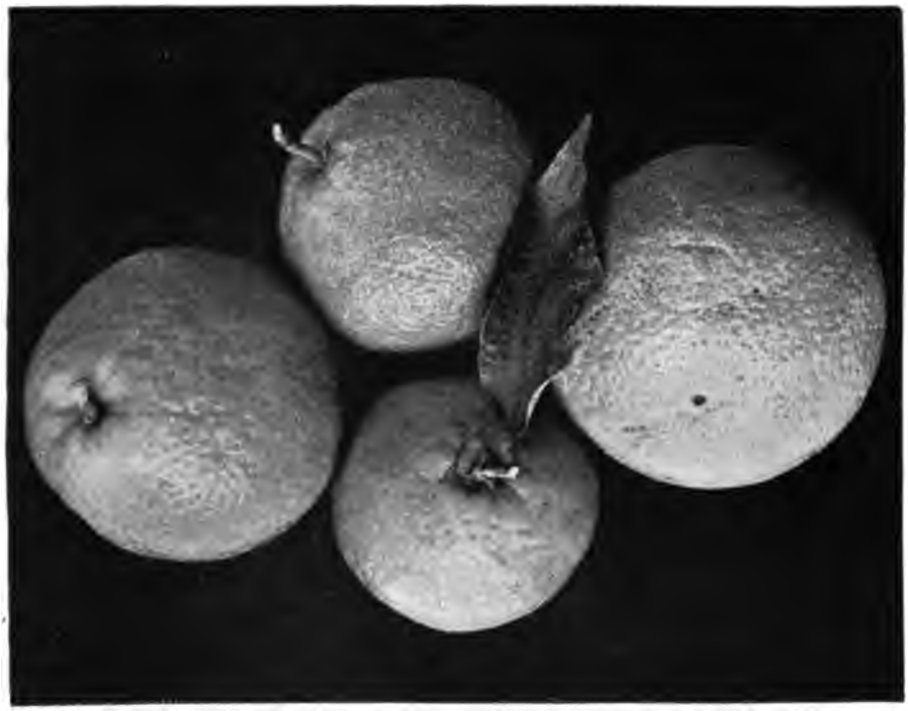


Four oranges attacked by Melanose, showing the curved markings caused by the peculiar arrangement of the small diseased spots. Though these small spots may run together, more or less, so as to cause brownish patches somewhat resembling Maori, they never become amalgamated into the uniform continuous colouration characteristic of the latter disease. However much they may run together they never cease to be spots; so that any patches of colouration they may cause are discontinuous—palpably made up of spots.

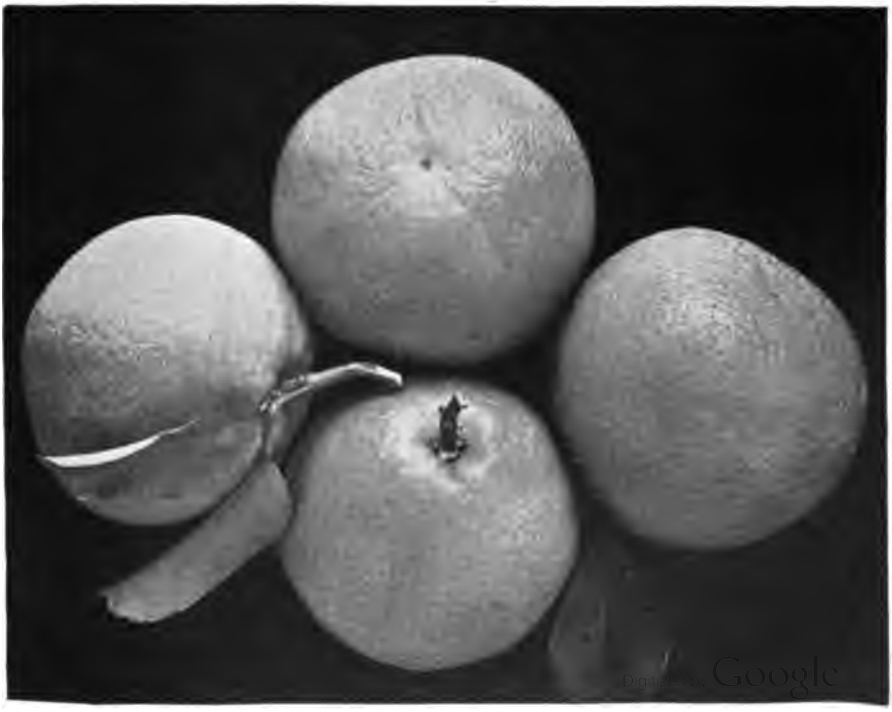
MELANOSE.

Mr. W. C. M. Owen, of Pennant Hills, tried the treatment recommended by Dr. Cobb for Melanose, and the accompanying illustrations show the results. Full details of this experiment appeared in the *Agricultural Gazette*, September, 1897.

FROM ORANGE TREES (*Treated*).

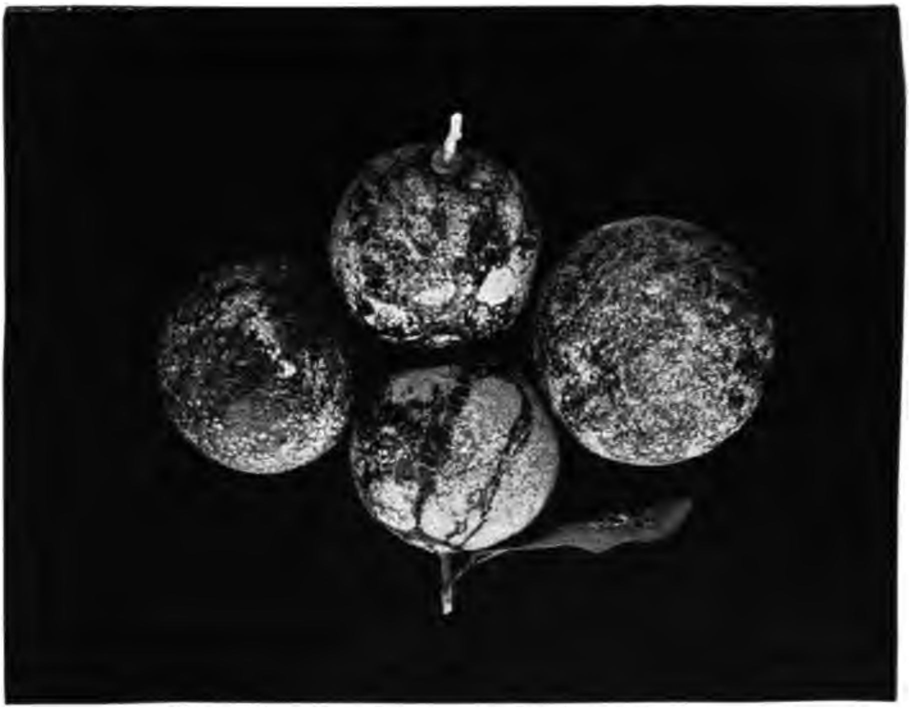


Fair sample of the worst oranges on a sprayed tree.

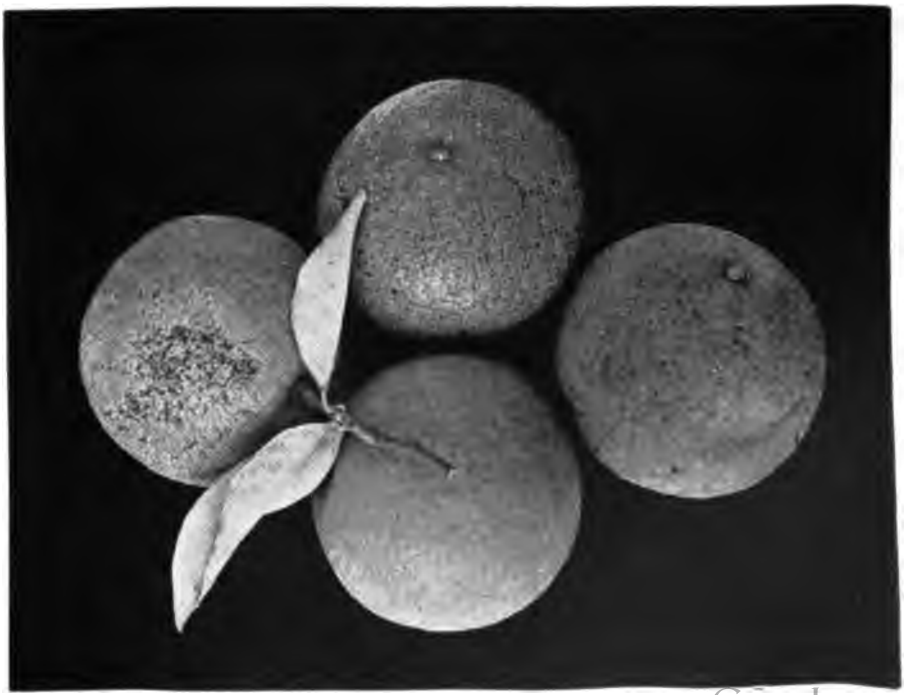


Fair sample of the best oranges on a sprayed tree.

FROM ORANGE TREES (*Not Treated*).



Fair sample of the worst oranges on an unsprayed tree.



Fair sample of the best oranges on an unsprayed tree.

3. Spray the trunk and larger branches with thin whitewash or full strength Bordeaux mixture.

4. Apply to the ground under each tree half a pound or more of sulphate of iron in 25 gallons of water; all the better if applied during a dry spell.

5. Give the trees phosphate and potash manures, but avoid organic nitrogenous manures, such as dried blood and rich stable manure. The use of somewhat bleached stable manure that will act also as a mulch is not hereby deprecated.

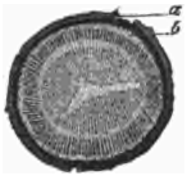
6. See to it that the drainage is good. Bad drainage is a prolific source of disease among orange trees.

7. Where the use of too much organic nitrogenous manure has already caused a rank soft growth of foliage particularly subject to disease, this objectionable material may be absorbed from the soil, according to Webber and Swingle, by allowing the weeds to grow.

8. If possible, induce your neighbours to adopt these precautions. Your fortune is more or less bound up in theirs, so far as contagious diseases are concerned.

Mal di Goma.

This is a disease of the bark of citrus trees which rarely extends more than 18 inches above the ground, and hence is sometimes also called collar rot. It attacks trees of all ages, and is more particularly found where the drainage is bad. The bark first of all turns yellowish, and has a gummy consistency and a sour or fermenting odour. The disease continues to spread until, in some cases, the tree is girdled and dies. Occasionally half girdled trees recover themselves, and go on growing and bearing, though the trunk does not heal over.

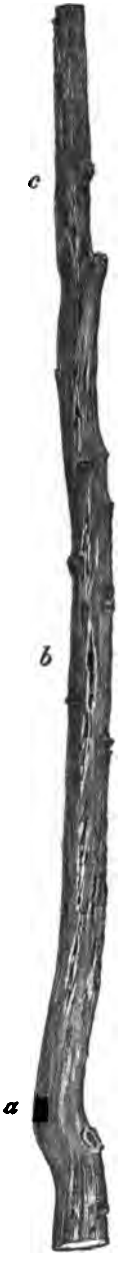


1

Cross-section, natural size, of the young orange-tree stalk shown in Fig. 3. This section was taken near *b* Fig. 3, and shows the effect of the disease. One of the cracks in the bark is shown at *a*. At *b* the effect of the disease is shown on the newly formed wood, which has become thickened.

2

Cross-section, natural size, of the young orange-tree stalk shown in Fig. 3. This section was taken near *c*, and is in a fairly healthy condition. The bark is shown dark, and the wood radiated.



Young orange stock, one-half natural size, the bark of which has been attacked by a fungus. The diseased bark is shown in the lower part, where it is more or less yellowish, being very much lighter coloured than in the upper part *c*. From *a* to *b* the bark is cracked. The fungus occurs more particularly in the neighbourhood of these cracks.

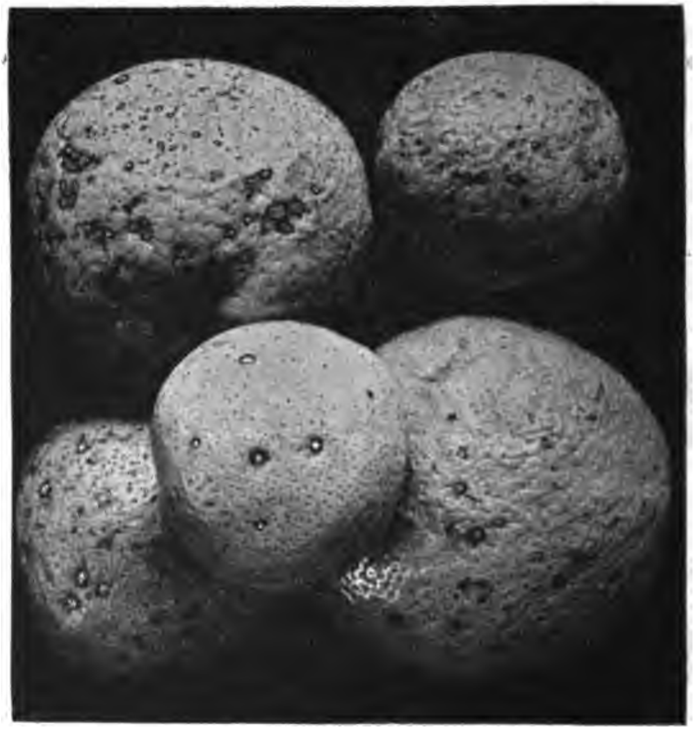
Observations have been made tending to show that this disease is caused by a fungus, but some doubt seems to exist as to the real cause. The illustrations herewith, show that in at least one case of apparent *Mal di Goma*, forwarded to me at my special request, a fungus occurred in the diseased bark. The nature of the case is well shown in the engravings and their subjoined explanations.

REMEDIES.

1. Cut away the diseased bark with sharp tools. Cut well into the wood and remove every particle of diseased-looking bark. It is better to cut away too much than too little. Burn the cuttings, and smear the cut surface over with grafting wax.
2. Remove the earth from near the base of the tree and apply two or three pounds of slaked lime.
3. Secure good drainage.
4. Avoid organic nitrogenous manures, such as dried blood and rich stable manure.
5. Whitewash the trunks with a spraying machine, or with a brush.

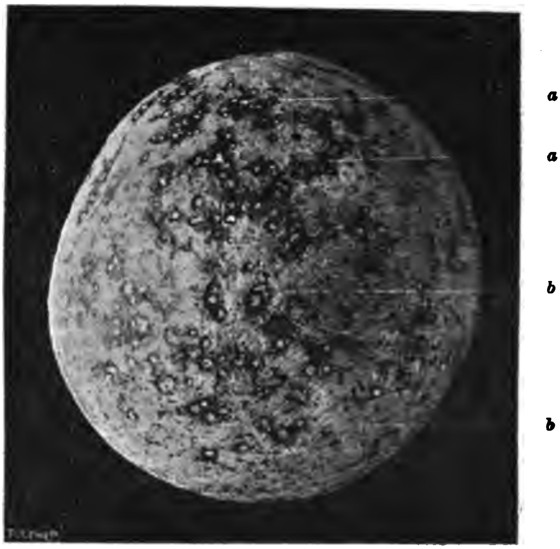
Black Spot of the Orange.

This disease is one that is very prevalent in some of the orange orchards near Sydney. Like Melanose it lowers the market value of the fruit. It also makes it impossible to keep the fruit in store, as the spotted oranges soon become rotten. The appearance of Black Spot on oranges is well shown in the



Oranges attacked by so-called "Black Spot." The diseased spots occur as more or less isolated roundish sunken, at first dark-coloured spots, the interior portion of which, however, at maturity is lighter coloured, with small dark spots (pustules) at the points where the spores break forth. These five oranges show no other disease; all the various defects seen on the skin are due to Black Spot.

illustration on the preceding page. It will be seen that the round sunken spots are large and conspicuous, and seriously mar the appearance of the fruit. The central part of each spot becomes greyish or whitish when the fungus causing the disease is mature, at which time several minute dark pustules appear in each spot. These pustules give rise to a multitude of spores, which arise after the manner of those of the genus Gloeosporium. It is therefore possible that the Australian form is the ***Colletotrichum adustum*** of Ellis.



Orange attacked by both Black Spot and Melanose. ***a a*, Black Spot ; *b b*, Melanose.**

The amount of damage done by this disease is variously estimated, but is on the whole, I think, exaggerated. According to my observation it causes much less loss than Melanose, though in some orchards the Black Spot predominates, and in such cases is responsible for much damage.

REMEDIES.

1. Laboratory observations show that even dilute Bordeaux mixture poisons the spores of the fungus causing Black Spot. This points once more to the use of this well-known mixture as a preventative. From the nature of the fungus it is plain however that the spray can act only as a preventative, and therefore the treatment should be begun early, and continued right through the season, and results must not be expected to be completely satisfactory the first season. This is owing to the deep-seatedness of the fungus causing the disease. It will readily be seen that if a disease-producing fungus is growing under the surface of the skin no spray except such as would destroy the skin of the fruit can reach the source of the disease. If, however, a weak Bordeaux mixture be persistently applied, all the spores that arise from the fungus will be killed as fast as they come to the surface, and this must in time stay the spread of the disease. The strength of the mixture should be the same as for Melanose. Begin as soon as the fruit sets, and spray regularly once in about ten days for the entire season. Of course this need not be kept up indefinitely.

Verrucosis.

This is a disease that affects lemons particularly, giving rise on the fruit to unsightly warts of a light brown colour which are particularly noticeable on the lemons when they are green. The disease causes many young lemons to drop off, and it so deforms many others as to cause them to be comparatively worthless. The disease is of fungous origin, and is said to yield to systematic treatment with Bordeaux mixture. For specific directions the reader is referred to the remedies given under "Melanose," p. .

Maori.

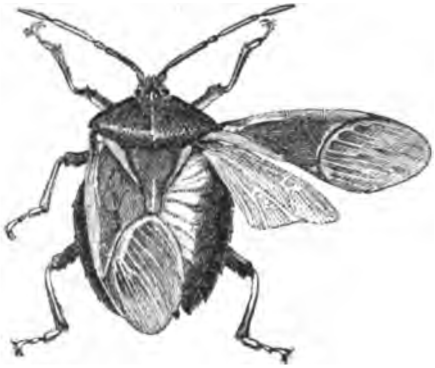
This disease, illustrated on page 354, caused by the presence of rust mite, may be kept in check by the use of soft soap and sulphur. Boil 1 lb. sulphur in 2 quarts water for 10 minutes; add 3 lb. soft soap to the mixture and dissolve. Add sufficient water to bring the whole up to 4 gallons, and spray.

Die-back.

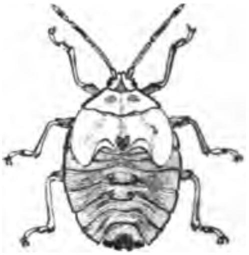
This disease appears to be somewhat uncommon in this country, but cases have been referred to me that appeared to be no other than cases of die-back. There was the same abundance of small foliage of unnatural colour, and so forth, but the matter must remain unreported upon until I obtain further information, to which perhaps some of our orchardists may assist me.

Caterpillars.—Weevils (Dicky Rice) and all other insects devouring the foliage. The simplest and most efficacious remedy is the spraying with Paris green, at a strengh of 1 ℔. of Paris green to 160 gallons to 200 gallons of water.

Borers of all kinds.—Remedy: inject turpentine into the hole and plug it up. Destroy mature insects wherever found.



BRONZY ORANGE BUG.
(Both magnified one-third larger than natural size).



LARVA OF BRONZY ORANGE BUG.

Bronzy Orange Bug.—The young insects may be killed by the use of kerosene emulsion, and the mature insects may be destroyed in the following manner:—Two or more men should tap with padded poles the branches of the tree on which the bugs are. This will cause all the bugs to run to the trunk and main branches, from which they can be swept on to a cloth placed on the ground round the trunk.

Insect Galls.—There is no known remedy other than cutting off the galls and burning them.

The growth of moss and lichens on the trunk, branches, and leaves.—This is easily kept down by the use of lime wash or Bordeaux mixture.

Grasshoppers, caterpillars, and the various foliage and skin-eating beetles are most readily destroyed by spraying with Paris green. Crickets may be killed by means of poisoned baits.

LIST of Fruits, showing where to grow them, and what to do with them.

Variety.	Most Suitable Districts.	Most Suitable Soils.	Use.	Remarks.
Almonds.				
Brande's Jordan	Warm inland	Free, sandy loam	Dessert or export	As almonds are very early blossomers they should be grown in districts free from spring frosts. Two or more varieties should be planted together.
I.X.L.	"	"	"	
Nonpareil (Californian)	"	"	"	
Apples.				
Gravenstein	Coast and tablelands	Free loams, with friable clay subsoil.	Dessert or local market	Might export; a valuable early apple.
Emperor Alexander	"	"	Cooking, "	" "
Granny Smith's	" (Orange)	"	" " or export	A very choice cooking apple: keeps well.
Trivett's Seedling	"	"	" "	A showy mid-season fruit; makes good jelly.
Cleopatra	Tablelands	"	" " or export	Sells well on the London market.
Lord Suffield	"	"	Cooking, early, or local	Best early cooking apple.
Carrington	Coast	"	Dessert, "	Blight resistant; very strong.
Perfection	Tablelands (New England)	"	" local, or export	" very upright grower.
Jonathan	" "	"	" "	One of the best for cold districts.
Rome Beauty	Coast and tablelands	"	" "	Subject to blight badly in parts.
Monroe's	Tablelands	"	Cooking, "	Valuable late apple.
London Pippin	" (Orange, Yass)	"	Dessert, cooking or drying, export	The best all round apple for New South Wales.
Ribston Pippin	From coast to interior	"	" local, or export	Blighty; great favourite; will thrive on the Darling.
Stone Pippin	"	"	Cooking, "	Strong grower, heavy bearer, good keeper.
Stewart's	Tablelands	"	" "	" "
Rymer	" (Goulburn)	"	" "	" " showy fruit.
Reinette de Canada	Coast and tablelands	"	" "	" " medium keeper.
De Niege	"	"	Dessert or local	Blighty; favourite on local market.
Bismarck	Tablelands (New England)	"	Cooking, local, or export	Heavy bearer; very large showy fruit.
Apricots.				
Royal	Coast, warm inland	Rich red or black loams	Dessert, canning, or drying	Very heavy bearer; does well generally.
Moorpark	Warm inland	"	"	Often a shy bearer; does well inland.
Blenheim	Coast, warm inland	"	"	Very heavy bearer; should do well on coast.
Hemskirk	Warm inland	"	"	Heavy bearer.
Peach	"	"	"	Large showy fruit of Moorpark type.
St. Ambroise	"	"	"	Large handsome dessert fruit.
Large Early	"	"	"	Valuable for the early market; the best really good early apricot.

LIST of Fruits, &c.—*continued.*

Variety.	Most Suitable Districts.	Most Suitable Soils.	Use.	Remarks.
		Cherries.		
Black Tartarian	Orange, Goulburn, New England, Monaro, for main crop; Young, Cootamundra, Inverell, for early crops	Rich, deep, well-drained loams	Dessert	Does well in the warm districts.
Centennial			,, and canning	Early, large, firm, and good.
Bigarreau Napoleon			,, ,, good shipper	Very heavy bearer at Orange and Goulburn.
Common Bigarreau			,, ,,	One of the best.
Florence			,, ,, ,,	Requires well drained land, late.
St. Margaret's			,, good shipper	Large and late.
Early Purple Guigne			,,	Very early; does well in warm districts.
		Figs.		
White Adriatic	All the warm dry parts of the colony produce the richest figs. They will grow, however, on the coast, but not to the same perfection	Any good soil; rich loams or deep sandy loams are the best	Dessert or drying	Strong grower dries well.
White Genoa			,, ,,	,, only makes n inferior dried fig.
Black Genoa			,,	
Brunswick			,,	
Brown Turkey			,,	
White Marseilles			,,	
		Table and Raisin Grapes.		
Black Hamburgh	Coast	Well-drained loams, or deep, sandy loams are the best soils for table grapes. The latter produce the largest crop. For raisins, warm, moderately rich loams are preferable	Dessert, local market	Not subject to black spot to any extent.
Black Muscat of Alexandria	,, and warm inland		,, ,,	Best black table grape.
Black Alicante	Warm inland		,, ,,	Good late grape.
Black Prince	,,		,, ,,	Sometimes a bad setter.
White Muscat of Alexandria	,,		,, raisins	Very subject to black spot on coast.
Gordo Blanco	,,		,, ,,	,, ,, ,,
Bowood Muscat	,,		,, ,,	,, ,, ,,
Sultana	,,		Sultana raisin	Must be pruned long.
Zante	,,		Currant of commerce	,, ,,
Baxter's Sherry	Coast and warm inland		Dessert	Strong grower; good bearer.
Waltham Cross	,, ,,		,, makes a fair raisin	
Centennial	Warm inland		,, ,,	Very large grape.
Gros Colman	,,		,,	,, late.
Dorradillo or Morrillion	,,		,, good shipper	Very late.
Thompson's Seedless	,,		Raisins	Similar to sultana.
Gros Guillhaume	,,		Dessert	Fine table grape.
Black Champion	,,		,,	,,

LIST of Fruits, &c.—*continued.*

Varieties.	Most Suitable Districts.	Most Suitable Soils.	Use.	Remarks.
		Oranges.		
Jaffa	Warmer parts of the interior, with irrigation. North coast districts from Hunter River north, Cumberland	Well-drained loams, rich inorganic matter, or deep sandy alluvial soils above flood-level	Dessert or export	Vigorous grower; fine quality; nearly seedless.
Washington Navel			,,	Requires a rich soil; best paying orange grown.
Mediterranean Sweet			,,	Weeping habit; early and heavy bearer.
Valencia Late			,,	Very long keeper; good quality.
Oval St. Michael's			,,	Very thin skin; fine quality.
Good Seedlings			,,	Strong growing trees; slow to bear, but long-lived.
Seville			Marmalade	Strong grower; good bearer.
		Olives.		
Corregiola	Warmer parts of the interior	Good deep soils, no matter if a little stony. Red or chocolate soil best	Oil	Makes a very fine, light-coloured oil.
Uvaria			,,	Grows in bunches; easy to gather; good oil.
Bouquetier			,,	Good oil; strong tree.
Verdale			,,	,,
Regalis			Pickling	Very large fruit; oil poor.
Macrocarpa			,,	,, ,,
Servillano			,,	,, ,,
		Pears.		
Williams' Bonchrêtien	Anywhere	Deep, rich soils	Dessert or canning	Most profitable all-round pear grown.
Marie Louise	Cooler districts	,,	Dessert	
Gansell Bergamot	,,	,,	,,	
Beurré Bosc	Coast and tablelands	,,	,,	
Beurré Capiaumont	,,	,,	,,	
Winter Nelis	,, warmer districts	,,	,,	
Madame Cole	Tablelands	,,	,,	
Uvedale's St. Germaine	Anywhere	,,	Cooking	
Catillac	Coast	,,	,,	
Butter	,,	,,	Dessert	Does very well on the coast near Sydney.
Keiffre's Hybrid	,, and warmer districts	,,	,,	Very free from disease.
		Persimmons.		
Hakeya	Coast, especially north coast	Medium loams. Will grow in most soils once they get a start	Dessert	Seedless; large fruit.
Yemon			,,	,, ,,
Tane Nashi			,,	,, ,,
Dai Dai Maru			,,	Large, flat fruit; good.

LIST of Fruits, &c.—*continued.*

Variety.	Most Suitable Districts.	Most Suitable Soils.	Use.	Remarks
Prunes.				
Prune d'Agen	Warmer parts of the colony. Inland districts, where there is 20 in. of rainfall; if less, irrigation is necessary	Chocolate or black	Drying	True French prune; very heavy bearer.
Robe de Sarjeant		Volcanic soil—any	"	French prune; early bearer.
Fellenberg		Good, deep loam	"	Italian prune; dries well.
Silver				A very large yellow prune dries well.
Plums.				
Cherry	Coast, and warmer parts	Any fair soil	Cooking	Very early; bad for pear slug.
Diamond	Coast	"	"	Very heavy bearer; large fruit.
Angelina Burdett	Tablelands or warmer districts where there is a fairly cold winter.	"	Dessert, dries well	One of the best dessert plums.
De Montfort		"	" "	Large, showy.
Prince Englebert		"	" "	Makes a very good prune.
Coe's Golden Drop		"	" " cans well	Very similar to silver prune.
Pond's Seedling		"	Cooking "	Very large, showy plum; poor quality.
Jefferson		"	Dessert, cans well	Fine quality; showy plum.
Reine Claude de Bavay		"	" dries well, cans well	The best of the greengages.
Peaches.				
Brigg's Red May	Dessert and canning peaches grow best on the coast; but drying peaches grow best in the warmer inland districts, with or without irrigation, according to the amount of rainfall	Light, well-drained, sandy loams are best	Dessert	
Governor Garland			"	
Early Crawford			" canning	
Foster			" drying	A fine-flavoured very handsome peach; does very well in the warmer parts.
Muir			" canning and drying	" "
Salway			" "	" "
Elberta			" "	" "
Susquehanna			" "	" "
Lady Palmerston			" drying	" "
Globe			" "	" "
Lord Palmerston			" canning	A large, handsome peach shy bearer.
Henrietta			Cooking "	
Yellow Italian			" "	
Nichol's Orange Cling			" "	One of the largest peaches in cultivation.
Shanghai			Dessert "	
Heath Cling			" "	
Lemon Cling			Cooking "	

LIST of Fruits, &c.—*continued.*

Variety.	Most Suitable Districts.	Most Suitable Soils.	Use.	Remarks.
		Nectarines.		
Hunt's Tawny	Coast districts, especially Cumberland county	Same as peaches	Dessert	Does not crack like Stanwick; is a good bearer.
Elruge			,,	
Napoleon			,,	
Stanwick Seedling			,,	
Victoria			,,	
Hardwick			,, or drying	
		Loquats.		
Mammoth	Coast districts	Any fair soil	Dessert and cooking	Mostly only one seed; superior to common.
Gigantic	,,	,,	,, ,,	,, ,,
		Guavas.		
Purple	Warmer coast districts Northern Rivers	Good free loam	Dessert and jelly	The hardiest variety.
Parker's Hybrid			,, ,,	Requires more heat large yellowish fruit.
Gooseberry			,, ,,	Not equal to the two former.
		Pines.		
Common Queen	Northern rivers only	Rich sandy loam	Dessert and canning	Roughed leafed variety; good quality.
Ripley Queen	,, ,,	,, ,,	,, ,,	Variety of former.
Smooth-leafed Cayenne	,, ,,	,, ,,	,, ,,	Large coarse pine; poor cropper.
		Bananas.		
Cavendishi (Dwarf)	,, ,,	Rich loams containing plenty of leaf mould	Dessert	Dwarf grower; the so-called Chinese or fig banana.
Sugar	,, ,,		,,	Tall grower; hardier than the former kind, though requiring richer land.
		Pomegranates.		
Ruby	Any part of the colony except the colder districts.	Good free loam	,,	
Paper Shell		,,	,,	

LIST of Fruits, &c.—*continued.*

Varieties.	Most Suitable Districts.	Most Suitable Soils.	Use.	Remarks.
		Quinces.		
Apple-shaped	Any part of the colony	Any kind of soil; will stand more wet than other fruit trees.	Cooking and jelly	The best of the quinces.
Portugal			" "	
Rae's Mammoth			" "	
		Medlars.		
Monstrous	Any part of the colony except the hottest districts.	Good loamy soil; similar to pears	Dessert	
Dutch			"	
Nottingham			"	
		Custard Apples.		
Bullock's Heart	Northern rivers only	Rich loam	Dessert	Will only grow to perfection in the warmer parts of the Northern rivers district.
		Nuts.		
Walnuts—Common	The tablelands	Sandy alluvial land with water 25 feet from the surface	Dessert and oil	Large tree; good bearer.
Dwarf Prolific	Sandy alluvial land in any part		"	Small tree; early bearer.
Mayette			"	Large nut; good quality.
Frankette			"	" "
Chestnuts—Spanish	Most parts of the colony	Sandy or sandy loam	Dessert and cooking	
Downing	"	Alluvial soil	"	
Maron de Lyons	"	"	"	
Filberts—Cosford	Only coldest part of colony	Medium loam, with cool, clayey subsoil	Dessert	Several kinds of filberts should always be planted together in order to secure a crop.
Lambert	"		"	
White Filbert	"			
		Citrus Fruits other than Oranges.		
Lemons—Lisbon	County of Cumberland	Well drained, free loam, containing plenty of organic matter	Various	So far the best variety.
Variegated	"		"	Much hardier than the Lisbon.
Villa Franca	"		"	Hardier than Lisbon; not fairly tested yet.
Improved Sicily	"		"	A strong grower; not fairly tested yet.
Citrons—Lemon-shaped	Northern rivers	Well drained, free, sandy loams.	Manufacture of peel	A heavy bearer in the northern rivers district.
Bengal	"	"	"	

LIST of Fruits, &c.—*continued.*

Variety.	Most Suitable Districts.	Most Suitable Soils.	Use	Remarks.
		Citrus Fruits other than Oranges—*continued.*		
Mandarins—Thorny	Northern rivers	Well-drained, free, sandy loams.	Dessert	Grow well round Sydney, but much better on the northern rivers.
Emperor	"	" ..	"	
Scarlet	"	" ..	"	
Limes—Tahiti	"	" ..	For its juice	A very fine fruit; very superior to the West Indian. Seedless.
		Berries.		
Blackberries—Lawton	Tablelands	Deep, rich, black loam ..	Dessert, canning, or jam ..	Require plenty of water.
Kittatinny	" warm districts with irrigation.	" " ..	" " ..	" very heavy bearer
Wilson Junior	" "	" " ..	" " ..	" early
Currants—White Dutch ..	" cold winters ..	Rich friable loams	Cooking	
Carter's Black Champion ..	" " ..	" "	" jam or jelly	Require plenty of moisture and cold winters
Black Naples	" " ..	" "	" "	" "
La Versailles (Red)	" " ..	" "	" "	" "
Grape (Red)	" " ..	" "	" "	" "
Gooseberries—Billy Dean (Red)	" " ..	" "	Dessert, cooking, or jam	Require plenty of moisture and mulching
Crown Bob "	" " ..	" "	" "	" "
Ploughboy "	" " ..	" "	" "	" "
Roaring Lion "	" " ..	" "	" "	" "
Rifleman "	" " ..	" "	" "	" "
Whitesmith (White) ..	" " ..	" "	" "	" "
Green Overall (Green) ..	" " ..	" "	" "	" "
Gunner (Yellow)	" " ..	" "	" "	" "
Raspberries—Fastolf (Red) ..	Tableland—warmer districts with irrigation.	Rich, red, or black volcanic loams or alluvial.	" "	Will grow in warm districts if well mulched and watered.
Northumberland Fillbasket (Red).	" " ..	" " ..	" "	" "
Antwerp (Red)	" " ..	" " ..	" "	" "
Common Yellow	" " ..	" " ..	" "	" "
Strawberries—Arthur	Any part the colony with water.	Strong, well drained loams	Dessert or jam	Keep down the strawberry leaf blight; mulch and water well.
La Marguerite	" " ..	" " ..	"	" "
Trollop's Victoria	" " ..	" " ...	"	" "
Captain	" " ..	" " ..	"	" "
Edith	" " ..	" " ..	"	"
British Queen	" " ..	" " ..	"	" "

Viticulture.*

THE VINEYARD.

In forming a vineyard it should always be borne in mind that the work is being done for a long succession of years. No return may be expected for the heavy outlay it involves for the first four seasons, although it is safe to expect that for a great many years after, the vine-grower will be recouped handsomely for the money, thought, and care spent in establishing the vineyard.

In the matter of vine-growing, especially, it is more profitable never to do things by halves, and each vine-grower should be well impressed with the fact that a 5-acre vineyard, well planted and carefully tended, will produce a crop nearly as heavy as 10 or 15 acres of slovenly cultivated vines, just stuck in a crude, unhealthy soil, badly drained, aërated and stirred. The vines, moreover, will be more luxuriant, longer-lived, the crop more healthy and more abundant, while the produce will be more easy to handle, infinitely superior in quality, and at the same time the toil, risks, and anxiety to the grower will be considerably lessened.

In a country like Australia, where vine-growing has not yet attained the importance as one of the leading national industries which can be predicted for it, many embarrassing questions present themselves to intending vine-growers, to a great many of whom the cultivation of the vine and, still more, the art of wine-making is quite a novel experience. It may be said that a considerable amount of judgment has to be exercised by them in the successful pursuit of an industry to which they have not been brought up, but up to which they are getting gradually educated.

Another class of vine-growers, and yet not always the most successful, are those who, coming from countries where vine-growing has been for centuries the leading industry, think at first that the Colonial methods are radically wrong, and substitute, for a time at least, under circumstances very dissimilar, some of the time-honoured practices they have been familiar with from their childhood. Soon, however, they gain local experience, and as they modify their views the better they thrive.

Differences of climate and of soil, it is well known, dictate the choice of different varieties of grapes, and, also, the distance apart they should be planted, the height of the stock above the ground, and the method of pruning. There are certain principles, however, in vine-growing that hold good under all climes, and which need only be modified to suit circumstances.

Choice of Soil.

The vine is one of the hardiest of cultivated plants, although the quality of its produce is influenced to a very great extent by local conditions. It grows in almost all kinds of soil. A typical and congenial soil, however, for vines, is a porous, easily working loam, deep by preference, with a healthy subsoil, naturally well drained, to which both air and warmth can penetrate from the outside, and which at the same time is sufficiently retentive of moisture to freshen the roots of the plant and permit it to resist the most severe drought.

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* [Compiled from articles on The Vineyard and Cellar by J. A. Despeissis, M.R.A.C., late Viticultural Expert to Department, and by M. Blunno, Viticultural Expert.]

The object the vine-grower intends to pursue should to a great degree influence his selection of soil for planting his vineyard.

For "table grapes" it may be stated that the richer the soil the finer will the grapes be, and the more handsome and well nourished the bunches, with well set and nicely swollen berries.

The choicer "wines," on the other hand, are produced in soils of a poorer description, and especially on light sandy loams. In the case of wine it often happens that quantity is adverse to quality, and on very rich alluvial flats, for instance, the must sometimes contains an excess of albuminous matter, which affects the keeping quality of the wines, while the bouquet is lessened, and a peculiar earthy flavour, disagreeable to the palate and the nose, is distinctly perceptible.

A very sandy soil gives generally a dry, thin wine, and if the season be moist the colour may be poor. The wines, however, produced on these soils are generally straight to the taste—that is to say, can be blended with most other wines, in order to dilute them, without changing their respective characters.

A heavy clay soil, on the other hand, produces a full-bodied wine, heavy, rich in extract, and in some cases may impart to it a peculiar flavour known as an "earthy taste."

Between these two characters of soils there are other intermediate ones that partake more or less of the character of the one or the other, according to the respective proportion of their sandy or their clayey constituents.

On limestone formations the wine will be delicate to the taste, with a fine brilliant colour and a pleasant flavour.

Volcanic soils will produce vigorous dry wines.

Besides the geological character of the land, the natural flora which cover it give some indication as to its suitableness for wine-growing. In this country, generally, wherever the native forest Apple-tree, the *Casuarina* (she-oak), the white Cedar, and the yellow and white Box grow, the land may be almost certain to be eminently adapted for the growth of the vine.

In selecting a site, it is always advisable, in Australia, to have it as well sheltered as possible from the drying westerly winds or the scorching setting sun.

An easterly aspect is generally the best, as the vines then get the full benefit of the rising sun. In the zone, which extends along the coast, a north-easterly aspect is always the best, as great damage is often caused in vineyards by the wet southerly squalls, and a great quantity of grapes burst and rot on the bunches. Even the north-easters are very troublesome near the coast, and whenever it is possible the vineyard should be planted in an amphitheatre, or on the slope of hills formed in a circus, thus affording shelter from all quarters.

It is a fact worthy of notice that it is extremely difficult, in this Colony, to get the wine grapes to ripen evenly and thoroughly within a distance of 10 to 15 miles from the coast, while, other things being equal, the fungoid pests are always more troublesome in the damp coastal atmosphere than a few miles further inland.

A slope always assists drainage, but, more especially in the drier districts of this Colony, a vineyard always looks more luxuriant, and gives a better yield on the flats and on slightly undulating country, the reason being, that during the long droughts and excessive heat which sometimes prevail the slopes often get too dry, and the vine suffers considerably. During the heavy downpours of rain, too, that take place occasionally, tons and tons of soil are sometimes washed down the steep slopes, leaving the land denuded and deeply cut by the rush of water down the incline.

In the cooler climates, such as France, the slopes are generally planted in vines, in order to utilise the full amount of sunshine and warmth; but in this country of light and heat, shelter from the wind is of far greater importance, and should mostly be studied in establishing a vineyard.

Preparing the Soil.

The site of the vineyard having been selected, it remains to clear it if it has not yet been put under cultivation, and to prepare the soil for the plough. The grubbing is often done by contract, and the roots should be run to a depth of 18 to 20 inches, no holes to be filled in until inspected and authority given to proceed with the work. Autumn is the best time for ploughing, when the rain has softened the earth. Hand trenching is always a very costly operation, and except when the patch to be planted is very small, can better be dispensed with. The vine, however, like all other fruit-trees that occupy the ground for a number of years, does best in a thoroughly-stirred soil. The character of the soil regulates to a great extent the depth of the ploughing—a moderate depth is sufficient in rich, loose loams, while, conversely, in poorer soils or in heavy clays the plough should be run deeper.

It is reckoned that 1 inch of rainfall, covering 1 acre of ground, is equal to 100 tons of water per acre; similarly, taking the density of the soil as 2, as compared with water, we get for every inch we stir the soil deeper, 200 tons of soil per acre, which, by being broken up, are more easily penetrated by the rootlets of the plants in search of food. The soil at the same time is more thoroughly acted upon by air, warmth, and water, and reduced by their combined agencies during the process of weathering, being thus rendered more healthy, more mellow and suitable as a feeding-ground for the plant. A deeper subsoiling has, besides, the advantage, which should not be overlooked, especially in a hot and dry climate, of promoting the growth of the roots at some distance from the surface, and thus lessening the effects of drought.

In first ploughing or subsoiling in heavy and retentive soil the furrows should always be in the direction of the fall of water, otherwise it will lodge in the subsoiler's tracks and damage the vines greatly in wet seasons.

Although the heavy soils are those most benefited by thorough tillage, it is generally advisable, and experience has demonstrated, that even in the loose and shifting sands a deep stirring is always accompanied by a corresponding vigour and increase of yield in the case of the vine.

In most cases surface-ploughing and deep subsoiling should be recommended in preference to trenching proper. There are some special cases, however, when deep trenching previous to the establishment of a vineyard is beneficial; as, for instance, when a loose surface sand overlays a more compact subsoil, which is susceptible of improvement by being exposed to the disintegrating action of air, sun, and rain. In that case a deep furrow is turned by means of a strong trenching-plough, or two ploughs are made to run one after the other, each turning a furrow about 8 to 9 inches deep. In other cases, however, the surface soil is much better than the subsoil, which is little susceptible of improvement by the process of weathering.

The most economical and the best plan of ploughing this class of land is to turn with an ordinary plough, worked by three or four powerful horses, a furrow 6 to 8 inches deep, and follow up with a strong plough with the mould-board detached, or a subsoiler plough with a team of four to six horses.

In first breaking up the land bullocks are sometimes preferable to horses, as they give a more steady and better equalised pull in overcoming the considerable resistance offered by the meshwork of roots that exist in virgin soil.

In some instances deep subsoiling or trenching may be unnecessary, or not to be recommended, such as when the surface soil consists of a very thin layer overlying a substratum of loose and broken stones. In that case the naturally brashy character of the subsoil, by permitting the roots to penetrate it, renders deep tillage either unnecessary, or even unadvisable.

Under cooler climates, when the soil does not receive much warmth from the sun, and this case does not concern the Australian vinegrower, it is desirable to stir the soil as little as possible, and, moreover, to plant thickly, so as to dwarf the vine, and favour the growth of superficial roots, which will benefit by the full amount of heat from the sun's rays, while the grapes will be richer in glucose, and the wine of a better quality. In Champagne and Burgundy, for instance, the soil is only worked about 10 inches on an average, as against 18 to 24 inches in the South of France and in Algeria.

In Australia a thorough stirring of the soil to the depth 16 to 18 inches, according to localities and to soils, would certainly be not excessive, and would soon repay its cost over and over again, by the increased crops which may be expected.

The best time for ploughing is the autumn. After ploughing a thorough harrowing should be given, and as much grass and noxious weeds as possible removed and burnt.

The land is left in this rough condition all through the winter, and is again ploughed crosswise—not subsoiled—in the spring, and prepared for planting by means of more harrowings and rolling if necessary.

Should the ploughing be delayed till the spring, there may be brought to the surface a quantity of weed seeds, which will germinate and soon overrun the field; while, on the other hand, if the soil be planted in the autumn, the seeds which germinate in the early spring are killed by the second ploughing, harrowing, &c., which precede the planting, and besides, the land will have been thoroughly sweetened by the action of rain and air during the winter months, and the cuttings will strike better.

Laying out the ground.

With a view of facilitating the ploughing, scarifying, harrowing, picking, and other mechanical tillage operations, a vineyard should always be planted according to a symmetrical plan. Laying out the ground is therefore the next thing to attend to. Before this is done it must be decided—

1. What disposition to give to the vines, and whether it is proposed to plant them in squares, in quincunx, or in lines.
2. What distance is to be left between the vines.

In this climate, where the sum of the sun's heat is always sufficient for the complete ripening of the grapes, the question of orientation is not so important as under colder climates, and the direction to be given to the lines will be to a greater extent influenced by the shape of the field, the intensity of the westerly winds if in the interior, or the sea-breezes if in the coastal region. In places also where hail-storms sometimes occur and follow certain winds which generally come from the same quarter, the edge of the lines should be pointed towards the direction the wind blows, and never the flank, if it can be avoided.

Laying out the lines along the longer axis of the field rather than in the direction of its shorter axis also saves a considerable amount of time and exertion on the teams, which have less turning to do.

If the vineyard is to be laid on a slope with a very marked incline, the lines and the ploughings should follow the contour of the slope and be laid perpendicularly to its fall, so as to prevent in some measure the soil being washed down the incline during heavy downpours of rain.

Whatever disposition is given to the vineyard, the land should be exclusively planted in vines, and no other crop put in.

Planting in lines, when the distance in the lines from vine to vine is much less than the distance between the rows, is not the most favourable one to allow the full development of the plants, as it has been observed that whenever the roots of vines meet in the soil their vegetation receives a check. There may be as many grapes formed, but they are not so large.

In fact, for a given number of vines planted in a given area of ground, the average yield of the vineyard planted in lines has been found to be in some cases as much as one-sixth less than the average yield of vines planted at equal distances from each other.

In hot and dry districts, where a thick growth of leaves would tend to cause the evaporation from the ground of a considerable amount of what moisture it contains, wide planting is generally resorted to, while in the cooler and moister districts, where the object is to promote the evaporation from the ground of as much moisture as possible, and besides encourage the growth of the roots nearer to the surface, close planting is the most profitable.

If we take France as an example, we notice a striking difference between the Champagne district, for instance, where there are as many as 16,000 to 20,000 vines to the acre, while the number decreases the further south we go, being 10,000 to 12,000 in Burgundy, 4,000 to 5,000 in the Hermitage, 2,000 in the Herault, and 1,000 in Algeria.

In Australia we find a considerable falling off in the number of vines per acre, viz.:

ft.	ft.				
6 x	6,	allowing space	for roads,	1,000	vines per acre.
7 x	7,	do	do	800	do
8 x	8,	do	do	650	do
9 x	9,	do	do	525	do
10 x	10,	do	do	425	do

The distance 10 ft. x 10 ft. and 9 ft. x 9 ft. are certainly excessive and an unwarrantable waste of space, while the cost of periodical ploughings and scarifyings, expenditure of money on land, putting up trellises, fencing, and in some cases rabbit-proof wire netting, are proportionately increased.

In the drier districts the distance 8 ft. x 8 ft. is a favourite distance, and it allows drays to enter the vineyard and carry away the grapes and the cut canes after the pruning.

Should the vines be trellised, 8 ft. between the rows and 6 ft. in the rows is preferable.

In many cases, and the distance which appears to suit best the widest vine-growing area of this Colony, is 7 ft. by 7 ft. if trained on stakes, and 7 ft. x 6 ft. if trained on trellises.

For the moister districts 6 ft. x 6 ft. is quite sufficient, and answers very well, while in some exceptional cases, such as in moist and cool districts, where the vines do not grow very rank, and all the tillage operations are done by hand labour, 5 ft. x 6 ft. and 5 ft. x 5 ft. are often advantageous.

The idea of planting wide apart is also to dispense with manures and allow the roots a larger range to feed upon. It may be asserted, however, that in the great majority of cases, by judicious manuring, and by the timely application of some 30s. to 40s. worth of suitable fertilisers per acre, an increase of threefold the money expended would be almost a certainty, while the yield would be more regular, the number of vines per acre might be increased, and the cost of tillage operations correspondingly reduced.

The explanation of the diminution of plants per acre, as shown above, as we proceed from the cooler districts toward the hotter or drier ones, is that it has been noticed that the development of the roots in depth corresponds with their development in surface. In the South of France, for instance, and in Algeria, where the object is to promote a luxuriant growth and an abundant yield, they must encourage by every means the growth of the deeper roots, which makes the plant independent of droughts and get for it nourishment proportionate to its yield. It is also evident that in dry soils where the mineral food required by the plant is not moistened and in a stat fit for assimilation, the plant requires a greater cubic space of ground than in moister and richer soil.

Besides planting in lines, the vines are very often, and in this country very generally, planted in squares and quincunx.

The planting in squares is the simplest, and, considering it all round, the one to be generally recommended, as the field implements can be run from one end of the vineyard to the other without turning, and the working is thereby greatly facilitated.

Planting in quincunx, or in diamond shape, with a vine at each corner of an equilateral triangle, is theoretically the best for putting in a given area the greatest number of vines, and it also allows the teams and implements to travel in three directions, but it is questionable whether working the teams only in two directions, as in the case of vines planted in squares, is not amply sufficient,. and, if the vines are trained on trellises, the tillage operations need of necessity be made in a straight line only, and in that case the advantage of having the plants disposed in quincunx almost disappears. With the quincunx disposition a very considerable amount of time and labour is wasted in having to turn every few vines as the implement which works the vineyards diagonally gets nearer and nearer to the corner of the field.

Whichever disposition it has been decided to give to the vines, it is important that the operations of pegging out should be carried on with great care, as even a slight variation to the right or to the left of the rows would destroy the symmetry of the vineyard as long as it remains, and would besides make the working of it far more difficult, and expose the trees to considerable damage by the implements and animals in cultivating the land. Besides, the labour is the same, whether carried out in a slovenly manner or according to a methodical plan, while, in the latter case, the value of the vineyard, all things being equal, is considerably enhanced.

Provision should be made for a commodious headland all round the vineyard of about 18 feet to allow the turning of the teams and the free circulation of trucks and drays employed in removing the crop and the cut canes after pruning, and in carting stakes or manure on to the land.

Should the interval between the rows be rather narrow, ample road accommodation should be provided. For this purpose the vineyard may be divided into blocks of about equal size by roads 16 feet wide, running at distances of (say) 2 chains, with gangways cutting the trellises at right angle every chain, should this mode of training be adopted. Ditches for carrying away the running surface-water should follow the depressions of the field.

It is preferable not to have a quick hedge growing around a vineyard, for in that case the first row or two of vines close by always suffer to a certain extent from the proximity of the roots from the hedge. A quick hedge is, however, sometimes necessary for the protection of vineyards situated near a town or village, or along a public road. It is better, however, to dispense with them whenever possible, for although they protect the grapes to a certain extent against pilferers, they harbour a host of troublesome birds that do a vast deal of damage in the vineyard about the time the grapes ripen. Should a hedge or some trees exist already, and be found useful, a deep trench at least 2 feet deep should be run along it so as to cut off the growth of the roots towards the direction of the vines.

For pegging out the ground the directions given at page 275 for laying out orchards can be followed.

It is, whenever possible, advisable to lay the rows in a perfectly straight and continuous line, in the direction of the length of the field, as this plan considerably lessens the working of field implements, which, during the operations of ploughing and scarifying, may be started at one extremity of the field and pulled up at the other end, crossing over the road without having to turn every few yards.

The roads, as well as the space between the vines, should be scarified and kept clean and bare of weeds, as the roads on which grasses are allowed to grow prove a never-ending source of trouble and infection to the vineyard, the implements in turning carrying along with them fragments of these grasses that soon spread about and necessitate almost continuous scarifyings.

Planting.

Before planting a vineyard it should be decided what class of wine it is intended to produce, or whether it is thought more profitable to dispose of the crops under some other form, such as selling as table-grapes, or dried and turned into raisins.

The natural circumstances of soil, climate, and orientation should also influence the selections of the varieties it is intended to grow.

If it is intended to hasten the ripening of some late varieties of wine-grapes, the slope that receives the greatest sum of degrees of heat might be set apart for them. Again, some vines, such as the Malbeck, for instance, are much liable to the accident of *coulure*, or of imperfect setting of the flowers, when grown on low ground with bad drainage, and do far better on undulating ground. Table-grapes should be planted in the richest soil on the vineyard, more especially if they can receive a few waterings from the time of flowering till the moment the berries change colour.

Whatever kinds of grapes are planted, let each variety stand separately. The importance of using only American phylloxera-resisting stocks cannot be too strongly impressed upon the intending vine-grower. In some of the most famous and ancient vineyards in the Medoc near Bordeaux, the Cabernets, the Malbeck, the Merlot, and the Verdot are planted indiscriminately in the same field, but that practice has gone out of favour now; and although it is advisable to blend the grapes in the fermenting vats together, so as to ensure their several constituents to get incorporated thoroughly during the process of fermentation, this blending can be just as easily made in the suitable proportions without the different varieties of vines being grown indiscriminately together.

The advantages of keeping the varieties separate may thus be summed up:—

1. The vines look more uniform in the field, their habits of growth being similar, and a more delicate and perhaps superior variety of vine is not thus exposed to be dwarfed and choked in its growth by a stronger and more common sturdy vine.

2. Should a particular variety show a greater liability to be attacked by fungoid and other pests, it may receive extra attention, with a view of preventing the occurrence of, or even curing the disease.
3. The pruning according to the habits of growth of different varieties, the summer topping, peculiar mode of training, manuring, and getting cuttings true of their kind, for future planting, are made far easier.
4. The ripening of various grapes coming at the same time in the same district, under similar circumstances of treatment, the operation of vintaging can be carried on in a more systematic manner, the earlier varieties being picked prior to the later ones.

More especially in the case of a vineyard planted for wine-making, great thought and consideration should be given to the proper selection of a few of the choicest varieties which have proved best suited for the climate and soil; and on no account should the vinegrower have such a miscellaneous assortment of all kinds and descriptions of vines as are seen at some of the vineyards in these Colonies.

The most economical and the quickest way of stocking a vineyard is by using *cuttings*, as *seedlings* do not bear a crop until the sixth year at least, and besides, like most of our intensely-cultivated economical plants, they are altogether unreliable as regards what their fruit will be like, and they also show a great tendency for sporting and developing endless varieties of grapes.

The best cuttings are obtained from the middle portion of the bearing canes of the previous season, the wood being well summered, keeping for a long time, and striking root and budding readily.

The very tender cuttings are those that grow quickest; but they are also very apt to soon get dry, on account of the pithy condition of the wood, and are not to be relied on in average seasons and open-air cultivation on a large scale. It often happens that the plants they grow are, besides, of a weak constitution. On the other hand, hard and tough wood does not strike root so easily, and shows a tendency to grow more wood than fruit. Whenever, therefore, it is possible to do it, the middle part of a cane, made of well-summered wood, should be chosen, and the intelligent and industrious vine-grower only raises from canes which come from prolific stocks, and have themselves carried a heavy crop of fruit.

The joints should be short and numerous, and no cutting should be taken from a vine attacked by any fungoid pest, such as *anthracnose*, *oïdium*, &c., as they are as a rule less vigorous, and there is always the risk of propagating the disease and infecting the young vineyard.

These details having been attended to, cuttings will be obtained that will strike more readily and produce stocks that will soon bear a heavy crop of fruits.

The cuttings that strike best are those that have been freshly cut from the vine and planted soon after.

This, however, is not always practicable, as late pruning delays the bursting of the buds in the spring, and causes the vine to weep, thus weakening it,* whilst in some cases cuttings may have to be obtained from great distances.

A good packing for vine-cuttings, when sending them a long distance, is to tie them into bundles of 50 each, and put around them some straw very slightly moistened with water, and wrapped in more dry straw, and then put them in cases, which on arrival should be opened, the bundles taken out and placed in an open furrow in some place of the vineyard not liable to be flooded, and where the soil is loose and in a healthy condition.

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* This is to be avoided by an earlier pruning, especially in old vineyards or in vineyards grown in poor soil. To healthy, vigorous vines, and in rich, moist soils, it may be an advantage, as the excess of the spring aqueous sap might cause the abortion of the flowers (*coulure*).—M. BLUNNO.

The best time for planting is about the middle of the spring, in pretty moist districts, as at that time the surface soil has been sufficiently penetrated by the warmth of the atmosphere to favour the growth of the tender rootlets. In drier places, where the hot weather comes early, and the rainfall gets scarce as the spring draws on, the planting should be done at the beginning of the spring.*

It is of great importance to plant only such cuttings as are likely to strike, as if many blanks have to be filled in the season after it is always at greater expense, whilst the vineyard does not attain to its full bearing capacity until perhaps the fifth or sixth year. For this purpose, should the vine-grower entertain any doubt as to the striking capabilities of his cuttings—and some varieties, such as the Brown Muscat, for instance, are very hard to strike—the bundles are often taken from the trench where they have been lying and placed a few inches deep into water. After three or four days the bark gets spongy, and small wart-like swellings, covered with a little gelatinous substance, begin to show at the base. The cuttings should then be planted without delay, as the rootlets of the plant, looking like delicate white little threads, soon break out, and might be damaged during the operations of planting.

A sufficient number of cuttings only should be taken out for the day's planting, and holes should have been dug wherever a small stake has been set to mark the place where a vine will stand.

In soils of average, fair, and fine quality, freshly broken up, as is the case generally in Australia, no application of manure is necessary until the vineyard has been yielding its annual crop of grapes for a number of years.

The cuttings should be slightly bent in planting and placed a little slanting, especially in a soil dry and hot at the surface, as is generally the case in this country, and not horizontally and only 5 or 6 inches below the surface of the ground, as is sometimes practised in moist and cool climates, where the object is to place the cuttings as much as possible in the warmer layer of the soil.

Sandy loams do not show a tendency to crack in dry and hot weather; but in heavy soils, the ground, by contracting in dry weather, very often leaves an open space round the cutting, especially if it has been put in vertically, and without having been slightly bent. In that case, if some sand can conveniently be put round the cutting, well and good; if not, the hole should be well trampled down, up to about two-thirds of the length of the cutting, and the remaining third banked up with the gritty and well-pulverised soil, which should not be trampled down.

Short cuttings, with only one joint and two buds, will produce very vigorous roots, which will strike down deep into the ground, but they are also more apt to be affected by droughts, and are more suitable for stocking a nursery, where a convenient state of moisture can be maintained. A long cutting, on the other hand, by being deeply set in the ground, will be more independent of rain, but the roots which will come from each joint will be proportionately smaller.

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* In Australia, where the winter is not severe, the planting of the vineyard may be started even earlier, except in places much subject to late frosts; in any case the bud to be left above the ground should be well protected by heaping up loose pulverised soil, so that both this and those buried down may develop with the least interval of time.—M.B.

Cuttings 15 inches to 18 inches long are about the best for planting in this country, and only one of the buds should show above ground and not two or three, as will be seen practised sometimes. The complete covering of the cutting and of the terminal bud under some sand or loose soil delays the growth of the leaves which are the essential organs of evaporation of the plant, whilst the young roots gradually take hold of the ground and supply food for the requirements of the young plant. If more than one bud be too much exposed to the air and light the leaves may grow too fast, and as the evaporation through these organs is excessive, compared with the amount of moisture the tender rootlets can absorb, the young plant, after having shown a fictitious growth for a while, soon withers and gradually dies away.

A percentage of misses, variable with the season, the nature and state of the cuttings, the variety of vine (Muscat strikes with great difficulty) is to be expected, and, for filling up these blanks, which may amount to 60 per cent. or more in some cases, it is always advisable to keep a small nursery, from which rooted plants may be obtained.

Planting with *rooted plants* is almost a certainty, and these may be put in the ground during the winter, or, better still, in the autumn, unless the soil be too wet. They then make a start early in the spring. It is a common belief that plants are quite inactive during the winter; but this is not the case, and their roots carry on more or less actively their functions during that period, and grow a number of rootlets. Early planting, therefore, enables the plant to take hold of the ground, and make a vigorous growth when the spring comes round.

In rooting up from the nursery, care should be taken to injure the roots as little as possible.

The operations which follow the planting of a vineyard may be summed up as:—

Keeping the ground scrupulously clean and free from weeds, which would, by coming into competition with the young roots of the vines, chiefly spread near the surface, rob them of part of the assimilable plant-food contained in the soil.

Running a light scarifier, as often as occasion requires, to keep the surface loose and promote absorption by moisture while counteracting the excessive evaporation rendered more sensible by the capillarity of a hardened crust on the surface of the soil.

Pruning low the first winter, and rather late in the season than otherwise, as young vines have a tendency to push the growth of the leaves too early in the spring.

Tying up the young shoots against a stick to prevent their being severed from the stock by high winds.

Giving to the stocks the required height at the second or third pruning.

Filling up with rooted plants of one or two years' growth, as the case may be, any blank in the field.

Rubbing off tender branches of grapes, should any appear too early, in order not to tax the energy of the young plants.

The fourth year the young vineyard may be expected to bear a fair crop of grapes, which goes on increasing for two or three years, the yield being pretty well the same after that for a great number of years.

MANURING.

It is a wise plan before planting out a vineyard to submit samples of the soil for analysis, for while in some favoured localities there is in the virgin soil sufficient readily available plant-food to meet the requirements of the young vines until they come into bearing, the majority of soils are deficient in one or more essential constituents. When such is the case, it is necessary, in order to promote vigorous root growth and early maturity, to apply what may be termed fundamental manures. For this purpose an abundance of stable manure, well worked into the soil during the operation of subsoiling or trenching, is about the most satisfactory; but where such manure is not available, the thorough turning under of a partially matured crop of cow-peas or other green stuff, or the application of bone-dust or mineral phosphate at the rate of about 12 cwt. per acre, will provide a store which will furnish the deep main roots of the vine slowly but steadily with necessary food.

When the plants come into bearing care should be taken to ascertain the exact requirements of the vines. One way of doing this is to mark off experimental plots as described in M. Blunno's pamphlet on manuring vineyards (available on application to the Department).

The following is a complete formula recommended by Mr. Blunno for the treatment of bearing vineyards:—

Superphosphate of lime, from 1 cwt. 2 qrs. to 3 cwt. per acre.
Sulphate of potash, from 1 cwt. 1 qr. to 2 cwt. 2 qrs.
Nitrate of soda, 1 cwt. 2 qrs. to 2 cwt. 3 qrs.
Gypsum, from 2 cwt. 2 qrs. to 4 cwt.

Either nitrate of soda, or sulphate of potash, or superphosphate may be omitted, according to the results of experiments. Of course you should use more or less of these ingredients according to the greater or lesser fertility of your soil; but you should, if possible, keep the proportion between them, and not apply, for instance, a maximum quantity of superphosphate and a minimum of potash.

Superphosphates and gypsum should be applied during winter, so that they may have the benefit of all the winter rain.

Nitrate of soda must be applied in the beginning of spring, otherwise the winter rains would wash it away, because it is not retained by the soil, and it is very soluble.

Sulphate of potash may be given about midwinter, and about the same period may also be supplied stable manure or blood in form of compost.

All chemical fertilisers should be mixed with four or five times their volume of earth before they are applied, and put around the stock within a radius of 2 feet or so, and then covered in.

Put the superphosphate, with the gypsum, about 4 inches deep; the other fertilisers to follow.

The system of digging round each stock for applying the manures perhaps is expensive, therefore you could open two drills with the plough, very close to the stock on each side of it, and put the fertilisers in the drill. This method will be far cheaper, and also very easy.

Nitrate of soda, however, which should be given in the beginning of spring, must not be put deep in the soil, but only spread round the stock and then lightly covered in.

*PRUNING.

Winter Pruning

1st. The quantity of the crop is constantly in inverse proportion to that of the wooden development of the vine, *i.e.*, the more wood the less crop, and *vice versâ.*

2nd. The stronger and bigger every single reserved cane is, the less will be its tendency to bear fruits. Canes of average thickness are the most fruitful.

3rd. The vertical position of any spur or rod is very favourable to a large growth of wood and leaves, the inclined or horizontal inducing the buds to give fertile shoots; therefore any disposition or arrangement directed to check the course of the sap is always the best to secure the production of bearing wood, so that bowing and bending down the reserved long rods is a very good manner to trim the vine. Any wound, scar, knot, tie, or grips on the stem or canes of a very vigorous vine, by preventing the rush of the sap, and by somewhat weakening the plants, are likely to promote fruiting.

Besides this the vigneron must remember that suckers, say the canes coming from the wood more than one year old, will not, as a rule, bear shoots with grapes, so that they are always to be cut off except when one or more new branches are wanted to give the vine-stem a proper shape, and equalise the growth on each side of it. In this instance a sucker is even sought and assisted to grow. When one or two of them are lowly placed they may be kept in order to lower the vine-stem, which after several years since the planting may have attained a height not suitable to the adopted system of training the vines.

When the second year has elapsed the new arms grown out of the suckers will bear fruit, the old branches of the stem above the latter are taken away, so the plants are not only reduced to a normal height, but even renewed and strengthened owing to the suppression of old and wearied material (Fig. 1).

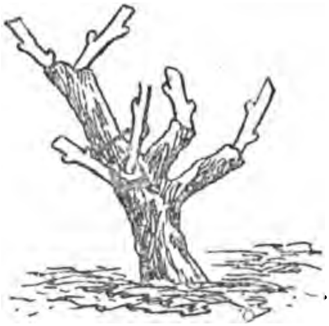

Fig. 1.—Showing where the old and overgrown branch should be cut off, leaving spurs for formation of new arms.

Time for Pruning.

No absolute time can be suggested as the proper one year in and year out for this operation; allowance must be made for variations of climate and earliness or tardiness of seasons. Roughly speaking, in districts north of the latitude of Sydney, June is about the best month, while in the southern districts, for the most part, July is the most favourable time to prune.

Where the vines have a tendency to produce an excess of wood and foliage at the expense of the fruit, pruning after the sap has started to move and the buds have commenced to swell will have good results.

If the vineyard, owing to its exposure, is subject to late frosts, the late pruning may often save the vines from injury, because it makes the buds shoot with a delay sometimes of a week or ten days, especially the lower eyes which mostly are to be reserved. These being still closed when the frost is likely to fall, are not affected by the freezing temperature.

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* M. Blunno, Viticultural Expert, *Agricultural Gazette*, June, 1897.

For old vines in poor or very dry soil the pruning should be earlier, so as to avoid an abundant bleeding, which would make the plants weak.

How to cut Canes and Branches.

Very little attention is paid, as a rule, to this particular of the pruning of the vine, and I deem it advisable to give a few hints concerning it to save several inconveniences which may follow through their neglect.

A rod should be always cut on the knot actually above the upper eye to be reserved. If you split a cane you see that the pith is interrupted by a diaphragm of hard and ligneous tissue in correspondence to each knot. It is just on this diaphragm that the cut should be made, so that protection may be afforded to the spongy tissue which the pith is made of (Fig. 2).

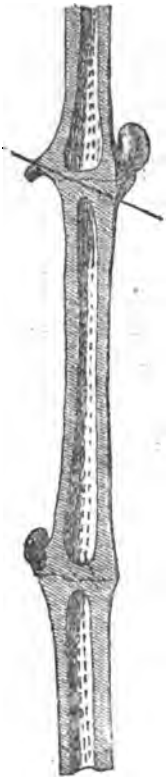

Fig. 2.—Line showing cut through ligneous diaphragm. (After Foëx.)

I know myself that this system of trimming would not give a nice appearance to the vine, on account of these stumps so being left over the last eye of the spurs; however, it is the best method. At all events, you may cut the interknot just on its middle for those varieties with long merithals (interknots), and a little higher for those which have them short.

The very common system of cutting just close to the eye is to be condemned, for the wood dries up to the distance of a few lines below the cut and the eye may be destroyed, or, at least, injured. Moreover, the cut should be made sloping, and the inclination on the opposite side of the position of the eyes, so that if the spur is vertically situated the flow of the sap may not injure them (Fig. 3).

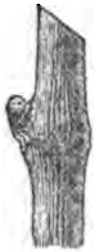

Fig. 3.—Showing the sloping cut with inclination opposite to position of eye. (After Foëx.)

Any branches of old wood to be shortened or removed at all should be always cut close to the insertion, and always with a sloping cut, so as to hasten the healing up of the wound. For all large cuts it is advisable to use grafting wax for protection against the action of the air, but the treatment of the wound with a fungicide* solution would serve better and be more speedy.

It is evident to the slightest observation how many vines last much less time on account of a sort of dry cancer which the cuts not healed are subject to, the cancer working below and invading a good part of the stem. To these neglected large cuts may be accounted the spreading of two vine diseases—the

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* See note next page.

malnero and the *rogna* (French *brussin?*)—which most likely are due to bacteria that find an easier way of invasion through any lesion or unprotected tissues.

All the germs of putrifaction floating in the surrounding air, or living in the soil, find a very suitable liquid to live in in the sap bleeding from large wounds, and then attack also the healthy tissues.

There is a very speedy way to prevent the penetration of these germs by applying to the wound the same solution as suggested for the winter dressing against the anthracnose* as soon as the cut is made.

Short or Long Pruning.

This is a vital argument intimately connected with the economical success of vine growing, and vignerons are so alive to the importance of it that I am often asked about this subject.

By short pruning is meant a system of cutting the rods to be reserved on the vine, from one to three or four eyes; when more eyes are left the method is called long pruning. The stumps of one-year-old cane cut back to two eyes are generally called spurs. When they are associated with rods of six to eight or nine eyes, then a mixed pruning will ensue.

Again, spurs in the system of short pruning play at the same time both the parts of giving fruit for the current season and wood for the next. In the case of pure long pruning one or two spurs are at times left, but while the production of the grapes is entrusted to the rods left long, the spurs are instead meant to give only wood for the pruning of the next season. It is, therefore, not so important that these spurs should be well placed as that the position of them on the stem should be such as to ensure good strong shoots that will become at the end of the season well summered canes for the pruning of the next year. Still, a simple bud can be induced to fill the part of spur. If, when stretching the long cane along the wire, the fold is made a little above the first or second bud, and a vertical position is given to those interknots upon which the buds are placed, it will be found that owing to their position being just on the direction of the flush of the sap, the same will develop in strong shoots, which, as a rule, will not bear fruit, or very little, but will become very strong canes of replacement for the next year, whilst the eyes placed on that part of the rod in a horizontal position, because of the sap checked at the fold, will develop in shoots not so strong, but will give plenty of grapes in compensation. (See Fig. 4, right hand cane.)

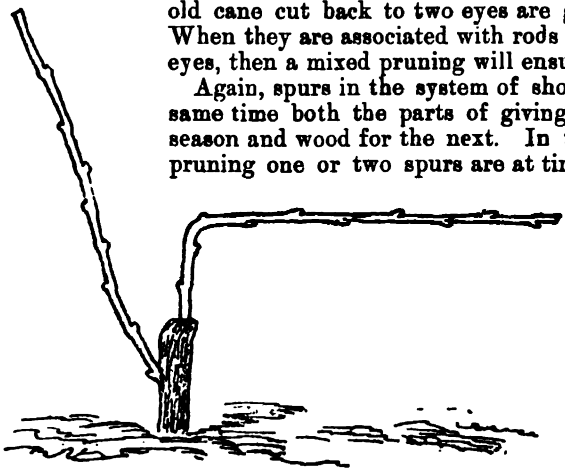

Fig. 4.

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* Concentrated solution of sulphate of iron :—

Sulphate of iron (green copperas), 5 lb.
Sulphuric acid (oil of vitriol), ½ pint.
Warm water, 1 gallon.

To avoid the spurting of the acid over the face and hands of the operator in preparing the solution, the sulphuric acid should first be poured over the sulphate of iron, and afterwards warm water added.

The unsuitability of short pruning for some kinds of vines is well known, as for instance the currants, while some others do well enough. The higher percentage of sugar in the must of short pruned vines is commonly admitted. But here there is hidden a question of viticultural economy that I wish to make plain. Some varieties without being unadapted to a short cut would pay far better, in my opinion, if pruned longer. The adoption of the long pruning for the Shiraz has proved a success also in these colonies, and I am sure it will be the same for some other grapes—For the Malbeck, to give one instance. As far as the Cabernet is concerned, it is well known that to get a crop that variety must be pruned long.

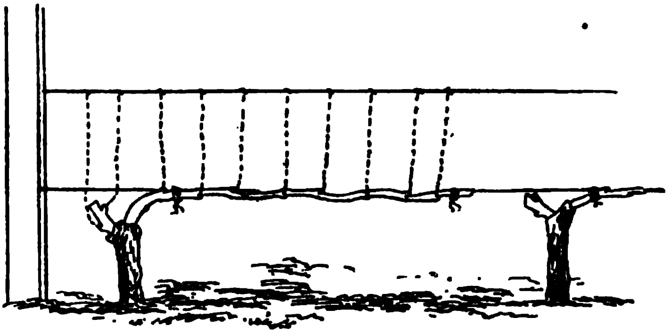

Fig. 5.—System named after Dr. Guyot (simple).

One objection might be raised from the part of those who believe only in musts with the highest specific gravity. A long pruning will give as a rule a heavier crop, but sometimes with a percentage of sugar a little lower, and a higher degree of fixed acidity. Well, from the point of view of a good and complete fermentation a too high specific gravity is other than a blessing; moreover these probable differences are very often most trifling.

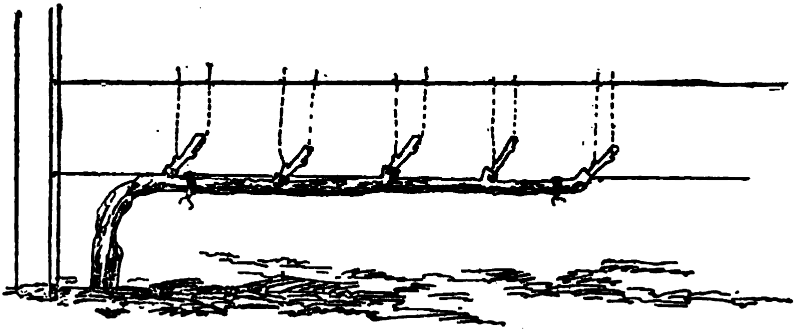

Fig. 6.—Horizontal cordon; unilateral, simple; also called Royat's system.

There is at present in the European wine districts a very favourable movement for transforming the old classic gooseberry-bush system of pruning into that of the horizontal cordon on single arm with spurs, or any other method which would allow of one, two, or more long canes being left to each vine, the aim being to increase the quantity of the crop without prejudicing the quality.

In Europe experiments have been conducted at different places and under reliable conditions with—

1. The common gooseberry-bush method.
1. The Guyot pruning, which consists of a rod with 6–7–8 eyes, stretched in a horizontal position, and a spur with two eyes to give the necessary canes for the pruning of the next year. (Fig. 5.)
3. Horizontal cordons on a single arm with spurs. (Fig. 6.)
4. The system of Cazenave-Guyot, consisting of a single horizontal cordon, on which are implanted spurs of two eyes associated with canes of 6 to 7 eyes. (Fig. 7.)

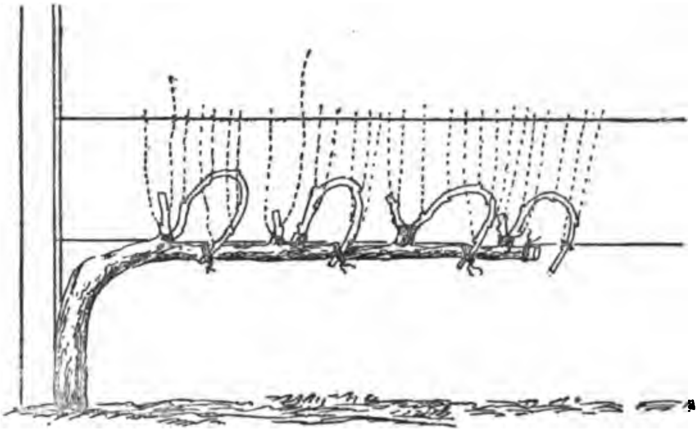

Fig. 7.—System of Cazenave, modified by Guyot.

The average number of eyes left was equal through all the systems in experiment; the soil quite the same throughout all the plot—say, loose, deep, fresh, and fertile; the same attention as to cultivation was paid, &c.; so the only difference consisted in the training of the vine.

The kinds of grapes first tried were the Cabernet and the Sirah (synonym of Shiraz), the following having been respectively the quantity of the crop per acre, its strength in saccharine matter, and the fixed acidity:—

Sirah.

Quantity of crop.	Percentage of sugar.	Percentage of fixed acidity.
1st system, 2,130 kilos.*	19·42	1·053
2nd ,, 3,333 ,,	18·88	1·057
3rd ,, 4,780 ,,	19·42	1·020
4th ,, 6,080 ,,	19·08	1·046
Cabernet.		
1st system, 2,330 kilos.	18·58	1·012
2nd ,, 3,221 ,,	18·38	1·027
3rd ,, 4,700 ,,	18·88	1·020
4th ,, 6,851 ,,	17·10	1·012

*A kilo=a little over 35 oz. avoir.

The percentage of sugar does not compare favourably with that we have here; but remember that these experiments have been carried out in a place where the musts, as a rule, never attain a higher standard than 21 to 22 per cent., owing to the climate of the district, which is rather cool and rainy. Therefore, the figures given do not lose their meaning when the question is regarded from a general stand point. What really is of interest to New South

Wales vignerons is the very trifling difference amongst the four systems for both the percentage of sugar and fixed acidity. For the Cabernet only, as may be seen, there is a difference of 1·78 per cent. of sugar between the third and fourth systems in favour of the former. The crops in the four systems adopted are in the same proportion as the numbers 1: 1·67: 2.25: 3 for the Siriah, and as 1: 1·38: 2·01: 3 for the Cabernet.

Perhaps it may be argued on the point that both these kinds of grapes have a preference for the long pruning, and the said preference would account for the larger crop; but, even with the third system—namely, of the horizontal cordon with spurs—the yield is more than twice that got from the gooseberry-bush training; and the horizontal cordon with spurs is considered to be short pruning.

Then taking kinds of grape that in their districts of origin are indifferently pruned short or long, the crops stand respectively like the numbers 1: 1·62: 2·83: 4·12, as may be calculated from the figures given in the following plans of M. Carlucci:—

Kinds of grape.	Goosebury-bush system. 1	Guyot system. 2	Cordons. 3	Cazenave-Guyot system. 4
Malbeck...	1·470	2.575	3·600	6·750
Meunier	0·433	0·380	1·200	1·250
Merlot	1·300	2·500	3·750	5·250
White Pinot	0·430	0·933	2·750	2·850
Grey Pinot	0·930	1·550	2·930	2·900
Muscatelle	1·400	1·675	3·850	....
White Gamay	0·700	1·500	1·500	4·625
White Traminer ...	0·600	0·400	1·325	3·000
Riesling	0·750	1·430	2·025	3·250
Italic Riesling	1·020	1·733	2·655	3·650
Average, per vine ...	0·903	1·467	2·558	3·725
Proportion	1·00	1·62	2·83	4·12

In many parts of Europe the horizontal cordon system is regarded as the most reproductive system of pruning, and is coming into general favour.

For the climate of the southern vine-growing districts, where rain is so scarce, I discard the fourth system, viz., the Cazenave-Guyot, as it requires the possibility in the vine of an exceedingly vigorous growth, which, as a rule, is impossible in very dry soils.

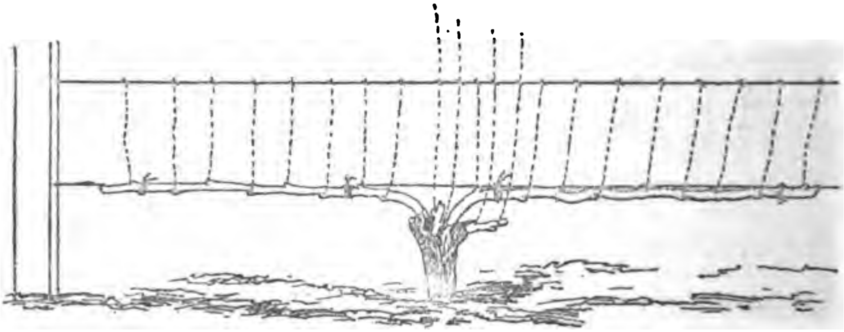

Fig. 8.—Double Guyot.

The cordons themselves are more suitable in districts where the vine can find enough moisture for bringing to ripeness the larger crop, and securing at the same time good canes for the pruning of the next year; and I would advise anyone about to try this system to go for simple cordons—say, not with double arms (Fig. 9)—so as not to push and force the vigor of the plants, because after a few very good vintages he would complain of an ever decreasing yield, owing to the exhaustion of the vines. Deeper and more frequent working of the soil and proper manures should help the vineyard to produce good crops for many years.

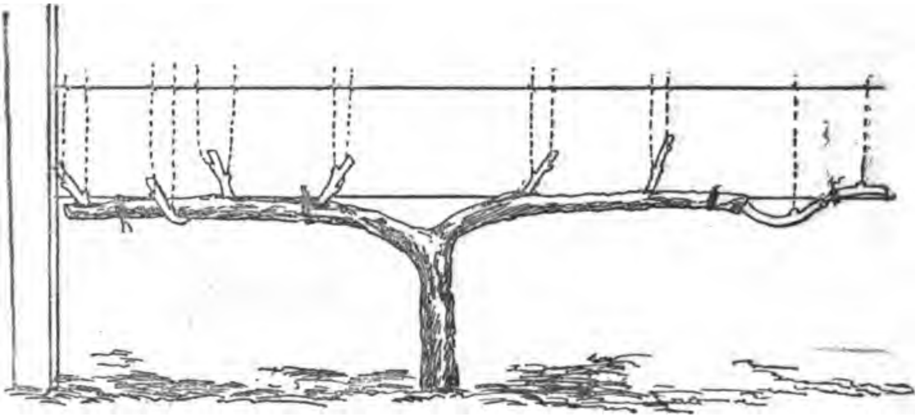

Fig. 9.—Bilateral, Horizontal Cordon.

The Guyot system consists of a long rod with six to eight buds, the rod being renewed every year through the canes coming from a spur left for this purpose: The yield is generally considered with respect to that of the gooseberry-bush fashion in the average proportion of 1·5 to 1. The said system is not so exhausting as the cordons and the Cazenave, so the need of manures is not so felt as in those two cases; but if the so-called double-Guyot method (Fig. 8) is adopted, there will be an increase of crop on that of the simple Guyot, necessitating more frequent labour, and from time to time—say, every two or three years—the application of sufficient fertilisers to restore to the vines what is taken from them by a more abundant fructification.

I do not, of course, exclude deep working and, from time to time, proper manuring for the vines pruned on the gooseberry-bush system, especially when with the spurs is associated a long rod (Fig. 10); I mean to say that attention to the land, and the refund to the soil of the nourishing elements taken away by the vines, is more necessary in the case of vineyards trained on a system of pruning which causes the vines to be heavy bearers. It is only a question of proportion.

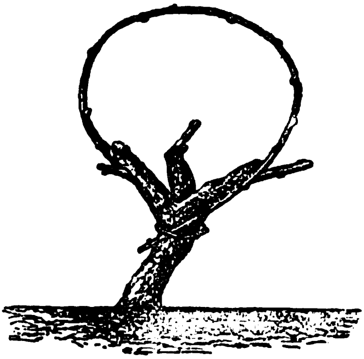

Fig. 10.—Gooseberry-bush, with long rod called in some districts of France *Flèche* or *Pissevin*, and in Sicily *Scaricaturo*.

When a long cane is left with the spurs on a vine trained on gooseberry-bush fashion of very strong wooden growth, care should be taken every year, at the time of pruning, not to leave this long cane always on the same branch, but a new arm should be selected to support it. This is necessary in order to equalise growth on all sides of the vine, which would otherwise become contorted.

In connection with the systems of horizontal cordons, Cazenave-Guyot and simple Guyot, there is the necessity of a special fitting of stakes, and of two wires stretched along the rows, which, beside the increase of the expense for the outlet, prevents cross-ploughing of the vineyard, requiring, therefore, more hand labour to work those strips of ground left along every row. This is somewhat a drawback to the above-mentioned systems; but, taking everything into consideration, the cordon method is more profitable than the gooseberry-bush. For my own part, I have no doubt that in the southern districts the Guyot system, either simple or double, would be found very advantageous; also the horizontal cordons would prove very profitable, especially in land with subsoil capable of retaining the moisture.

It will be generally admitted that the retention of sufficient moisture in the soil is of great importance under any system of treatment, and more especially is this the case where the system of pruning adopted is one likely to promote a vigorous growth of shoots far removed from the main stem.

Summer Pruning.*

Suckering and Disbudding.

By suckers are meant all the shoots which grow from the old stem and on any of its ramifications which are at least 2 years old. Generally, they do not bear fruit; occasionally they do.

But there are exceptions in which suckers, rather than to be suppressed, ought to be assisted and encouraged to grow.

To lower a stem which has grown too high, a sucker, lowly placed, is left and looked after, and on the next winter-pruning it is cut back to two or three eyes, while the upper, old, and worn-out stem is sawn off; so the vine is not only reduced to a normal height, but also, to a certain extent, renewed.

In old vines growing on poor and very dry soils, suckers must be carefully rubbed off. This operation may be performed by gently rubbing the stem with the hand if the suckers are just starting and their length being not yet an inch or so; but then, after a fortnight, the stem will again show some new ones, and this is mostly the case on some given varieties like the Aucarot, so the operation is to be repeated. If the suckers have been allowed to grow 4 or 5 inches, more attention should be paid to the *modus operandi*. As a rule, vignerons pluck off roughly these suckers; hence a lacerated wound, which denudes one of the strata of the bark—*cambium*. A stream of sap then flows to that wound; a callus is soon formed, from which, in very short time, more suckers shoot out; and the vigneron then has to contend with three or four of these sap-robbers, which may spring from the place of that one which was carelessly removed.

The best way to avoid this inconvenience is to cut off the sucker with the thumb and forefinger nails, leaving 1 inch of it on the stem. The little stump soon dries up, so any laceration of the bark is avoided.

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* M. Blunno, *Agricultural Gazette*, November, 1897.

Disbudding is the removal of the shoots, growing on one-year wood, which do not show any fruit. Such shoots are worthless, and, unless required for keeping the vine in proper shape, should be nipped off.

Pinching and Topping.

The reason of topping, generally speaking, is to conserve the sap for the better development of the canes, and the grapes hanging on them. This, like many other sound principles, is abused and misused in the practice; hence a failure, which is then accredited to the theory itself instead of to the method of performing the operation.

When we attempt to review all that has been published on the subject of certain practices of summer-pruning, such as topping, pinching, or suppressing some of the leaves, and when we think that what is written is not grounded on simple theory, but on the observance of the traditional systems of many vine-growing countries, or on regular experiments lasting for eight or ten years, and carried out by clever experts, we are struck by the difference of the results, and find that it is not very easy to plan out a rule to give the vignerons as their future guide on the matter.

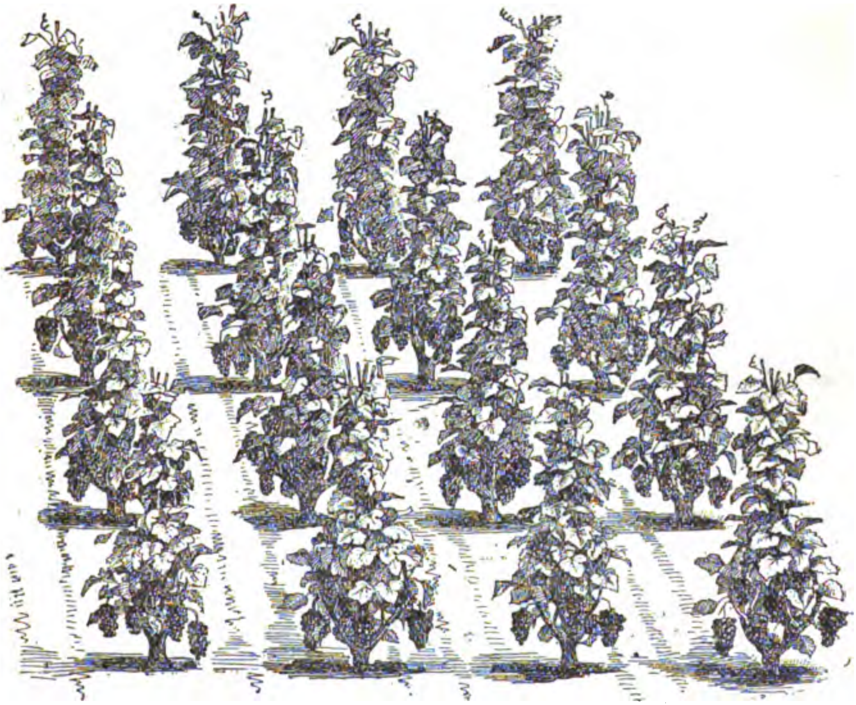

Fig. 1.

Every vine in healthy condition has more leaves than are really wanted. This, perhaps, may justify in some way the practice in some vine-growing districts of suppressing some of the leaves in order to expose the grapes to the beneficial effects of the sun, but I must not omit that, while this is perfectly right in cold climates, where the sunny days are not many, the system cannot be recommended in hot, sunny places. Here grapes need to be sheltered to avoid any scorching effect of the solar heat, which, when too severe, has a different result, *i.e.*, instead of promoting the function of assimilation inside of the leaves, checks it. In fact, many vignerons must have noticed that in very dry and hot seasons grapes do not ripen well. They look as if they were mature, as far as the colour of the berries is concerned ; but then the must is not so sweet, and is rather too acid, and the proportion of juice not so plentiful as in the years of normal summer temperature. Many must have also seen the beneficial effects of a good downpour during a period of very intense heat on the ripening of the grapes. The moisture in the soil in the surrounding air and the lower temperature makes the leaves and the grapes start their physiological work again, which work was nearly suspended.

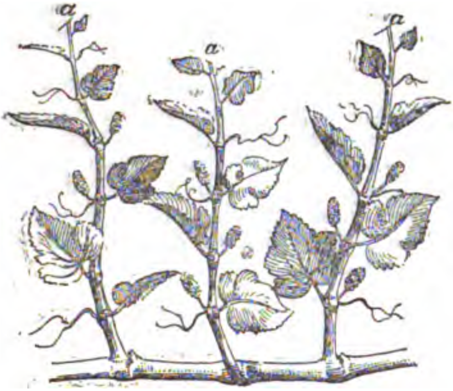

Fig. 2.

The top leaves of a vine-shoot—(say) those small leaves of the extremity which have not a normal size, and are not of a deep-green colour—do not do any effective work, because in them the chlorophyll is not well formed and scarce, so they are unable to do any work of assimilation to prepare the starch, which is the startpoint of the sugar. Hence one may suggest the expediency of doing away with them. I fall in with this idea, therefore the topping should only be limited to the removal of three or four inches, as is shown in fig. 1.

Many experts prefer the pinching, which then is done earlier—(say) soon after the flowers set. By only nipping off the terminal (see fig. 2 *a a a*), to which is entrusted any extension of the shoot, this is checked in its growth.

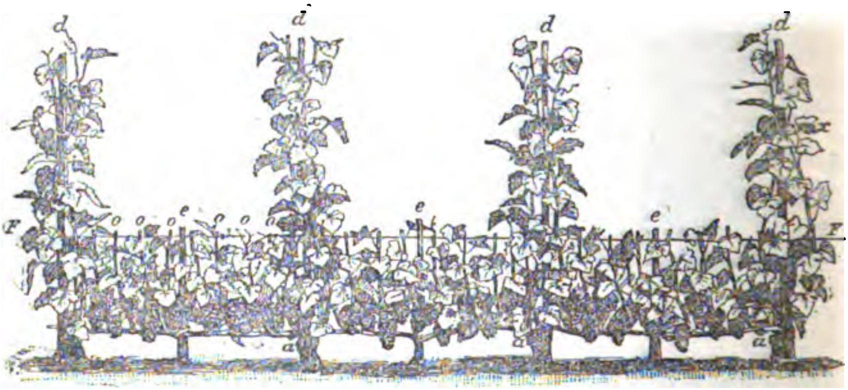

Fig. 3.

Fig. 3 represents vines trained on the Guyot system. The shoots bearing grapes (*o o o*) were pinched as they reached the height of the wire F, whilst these long ones (*d d*) on each stock of the same drawing, which sprung from the spurs are meant to furnish the canes of replacement for the next winter pruning; consequently, they are allowed to grow unmolested in order to obtain a respectable length.

The Figs. 4 and 5 represent two vines trained on the gooseberry-bush system, in which no topping was effected; but then the shoots, when they had reached a convenient length, were fastened and intertwined in the first instance, while in the second they were fastened, and the top twisted down.

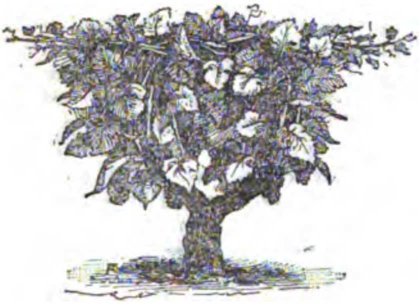

Fig. 4.

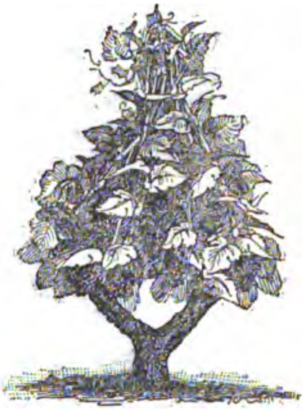

Fig. 5.

This method of bending and twisting the young shoots controls their profuse growth in length, and also the flow of the sap, which will be better elaborated. Furthermore, the shoots and leaves of each vine being kept together, do not hinder the easy working of the ground, and, moreover, the grapes are well sheltered.

Abortive Flowers.

When the flowers of the vine do not set and transform themselves into fruit there is a case of abortion (*coulure*, *colatura*). This may be caused by three different reasons, which we will consider separately.

Those who are a little acquainted with vine-growing must have noticed that on some particular kinds of vines the fecundation does not take place, hence any amount of berries are missed, and on examining those tiny flowers one can see that the male and female organs are not well developed. This is a constitutional affection against which nothing can be done. Among experts these flowers are called *coulards*. Some varieties of muscat are conspicuous for this inconvenience, while most of the American true species, and many of their natural hybrids have but *coulards* or imperfect flowers.

Sometimes the abortion of the flowers, even if, physiologically speaking, well constituted, is due to the invasion of parasites at the time of the blossoming, against which the preventive specific remedy suggested for each infection should serve to prevent the damage. When, during the blossoming, the temperature of the air falls rapidly, or when the blossoming coincides with a period of foggy weather, many flowers are missed, and often what would have been a bunch of grapes will be a tendril. This, however, is not much to be feared in our climate.

But often the fecundation of many flowers does not take place regularly, hence a scarce fructification, through the superabundant vigour of the vine, and consequently of the shoots, because of a strong flow of the sap, which is mostly characteristic of vines in low and wet soil. Then the flowers are "drowned," to translate the term used by the vignerons of some vine-growing districts of the Continent.

In the case of too much moisture in the ground, a good drainage would assist in preventing the inconvenience. If the strength is due to the high fertility of the soil, then more spurs or canes should be left on the stock at the time of the winter pruning.

Annular Incision.

Finally, there is the annular incision, to which the vigneron can resort. I say, however, that this could hardly be adopted as a general practice by a vigneron who owns some 40 or 50 acres of wine-grapes vineyard, and it is mostly considered suitable to those who grow some vines of table varieties. The operation consists in taking a ring of the bark off the shoot which the clusters of bunch hang on, and do so about one inch below the lower cluster (*see* Fig. 6) a fortnight before the time of blossoming. In this case the annular incision affects the one particular bunch which was operated upon.

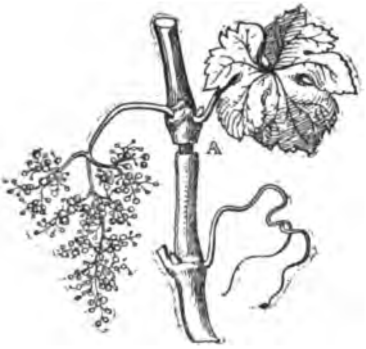

Fig. 6.

It may be performed instead at the time of winter pruning on the one-year canes or spurs.

Then the ring of bark is taken off a couple of inches from the insertion of the cane or spur on the stem. This annular incision so affects all the shoots which will spring from that branch.

The width of the ring of bark to be detached is not more than four lines, and attention should be paid so as to not hurt the wood underneath. The point of a sharp pen-knife may be used for this operation, though there are the so-called *pince sève*, which are now available for this purpose. A *pince sève* is a sort of scissors, each piece of the scissors having a double blade.

The wound heals during the same season, an accumulation of material just above the incision causing a sort of swelling, because the sap is kept back through this discontinuity. To explain this I must not omit that the sap, on the beginning of the vegetation, flows throughout the central part towards the top of the canes and shoots. Then it is in a sort of raw state, and during its ascension it becomes richer and more refined as it starts to descend (elaborated sap).

The operated part is weaker; hence, in accordance with one of the principles referred to on page 377, the plant is better disposed to fructification.

The grapes of incised vines are not only more plentiful, but the berries are also bigger, while the ripening is ten days or a fortnight earlier. I must say, however, that the shoots operated are brittle, and they should be bound to the vine stake in order that strong winds may not break them down. They also are difficult to handle at the time of the winter pruning, because of their brittleness.

The annular incision exhausts the vine a little, consequently cannot be repeated every year.

Pruning-tools.

A few directions as to the best may be found of use:—Pruning-shears, or *sécateurs*, will be found the easiest to handle, and they do the work quicker, and without jarring the vine as the knife does. A good *sécateur* should be quite 9 inches long, the blade not too long, and the prong made of hardened steel.* The shearing part is about one-third of the length of the tool, the other two-thirds constituting the levers, which, when released, are driven open by a spring, and thus made ready for the next cut. The blade, says Mr. Adams in a practical paper on the subject, should be kept sharp by means of the occasional use of a small hone, carried along with the other pruning-tools, in a small canvas bag made for that purpose, and strapped round the waist.

A clear and neat cut is given by seeing that the blade, and not the prong, is turned towards the part of the cane which is left on the tree. A piece of fishing-line or string twisted round the handles will be found less severe on the hand, and will give a better grip.

Pruning-saws should be put into frequent use to cut back old wood. The blade should be strong, and measure 12 to 14 inches long, and the teeth close set, and sharpened by the use of the file. The handle is curved, so that it can be hooked to the belt when not in use, thus leaving both hands free. Another very convenient saw is one with a bow made of steel, so as to be light and strong. The blade is narrow, and so connected with the wooden handle that it can be turned in any direction, and can be tightened by a screw and nut at the other end. By this means old wood, too tough for the shears, can be cut out without injuring the bark of the adjoining spurs.

A good English pruning-knife, with a strong well-ground curved blade, will be found useful for trimming the wood and giving it a smooth surface.

Layering

Is often practised for straightening vines that are not well in line, for renewing old vines, or for filling up gaps in the vineyard. Whenever it is intended to have recourse to layering, one or two canes are allowed to grow to their full length, and are tied up to a long stake.

Supposing it is intended to replace a missing plant. In the winter time, a ditch of the required length and about 10 inches deep is dug, extending from the stock to the place where it is intended to have the new vine, the roots being undermined, and cut off if necessary, and the vine bent down into the trench, and secured by means of hooked pegs. The end of the cane is curved up and cut a short length above ground, the ditch being filled up with the excavated soil, which should be well trampled down. Then the second cane is twisted round, and brought up where the vine originally stood, and cut likewise to a few inches above the ground. The vine will strike root at every joint, while life will be supplied in abundance through the existing roots, and a vigorous growth will ensue. No grapes will be borne by the plant the first season, but an abundant yield may reasonably be expected the season following.

Grafting

Is the most expeditious means at our disposal for substituting one variety of grapes for another, as for instance, when it is sought to change the character of the wine, or grow table or raisin grapes instead of wine grapes, or the reverse, as the case may be. For this purpose plough back to the stocks, by running the plough 4 inches deep and as close as possible to the vines; with a hoe remove the soil round the trunks, and saw off the top a few inches under the surface of the ground; with a chisel and wooden mallet make a wedge-shape cleft in the stump; the cleft is either lateral or a split is made across the diameter of the stump; in the second instance keep the lips of the cleft open by means of a small wooden wedge, and insert the scion, which is likewise cut wedge-shape, and is made a little thicker at the bark than nearer the centre; one or two scions, as the case may be, are thus inserted, and the wooden wedge being removed the split stump on closing will maintain them in position, and in many cases no ligature will be required. The surfaces of both stock and scion should adhere well and be in intimate contact with one another to insure the success of the graft, *i.e.*, the growing wood of the scion should be brought into immediate contact with the same layer of the stock. To make sure that this takes place, a slight inclination should be given to the scion, as then its inner bark is sure to come into contact at a certain point with the corresponding layer of the stock.

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* In cheap *sécateurs* the prong is sometimes made of iron, and soon gets blunt, losing its sharpness of angle, and, consequently, inflicting bruises on the wood, instead of making a clean cut. (P. F. Adams.)

A handful of a mixture of clay and cow-dung is pressed round the graft, the hole filled up with earth,* leaving one eye only of the scion above ground, and a stake driven in to indicate the spot and act as support for the future shoots.

Cuttings pruned from the vines make good scions; they are kept dormant by burying in moist earth in a cool place. The scions should be tied in bundles, care being taken whenever several varieties are intended to be grafted to fasten a zinc or a wooden label bearing some distinctive mark or notches, so as to make sure of the particular variety it is proposed to reproduce.

Some varieties are particularly adapted as graft bearers, and they generally are the sturdier and more vigorous sorts of vines; as for instance, the American vines, and among the European grapes, black Hamburgh, Grenache, Mataro, black Shiraz, &c. Muscats, on the other hand, and all delicate vines, do not make suitable stocks, and are better as scions on some more rustic variety.

September is the best month for grafting, when the sap has begun to flow, while air and soil have not yet been desiccated by the heat of the summer's sun.

Should a graft fail, the stump can be re-grafted the season after by cutting off below the previous cleft.

Another sort of graft called the "tongue" or "whip graft" is much used whenever it is desired to work a choicer European vine on phylloxera-resisting American stock.

Tying-up the Vines.

After the pruning, which should have been done from the end of June to the beginning of August, and the carting away of the wood that has fallen under the secateurs, nothing is seen on the vineyard except old stumps carrying short spurs of two or three eyes in the case of vines pruned short and stumps with a few canes of last year's growth 2 or 3 feet long, in the case of vines belonging to the varieties named in a previous chapter as giving better results when pruned long.

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* It is suggested to add to this mixture a small quantity of common salt. This should be dissolved in proportion of ¼ oz. per pint of water, which is used to well incorporate the clay and the cow-dung. The salt being igroscopic, *i.e.*, attracting the moisture from the surrounding atmosphere, keeps fresh the moisture all round the grafted point, so preventing the tissues from drying up. A mixture so prepared is commonly called S. Fiacre unguent.—M.B.

These long canes, which will carry the foliage and support the fruit-bearing shoots of the coming crop, must be tied up and made secure before the plant bursts into leaf, and also trained in such a manner that they will offer no impediment to the working of the scarifiers, horse and hand hoes, as well as to the free passage of the labourers along the lines, at the time of disbudding, summer-topping, sulphuring, and picking.

There are three modes of performing this work, according as the vine is trained—gooseberry-bush fashion, along a stake, or on a trellis.

In either case it is important that the same degree of inclination should be given as far as possible to the canes, arms, or runners of the same vines, so as to equalise the flow of the sap, which always shows a tendency to rush towards the extremity of the branch, more especially so when that branch shoots straight up. The object, therefore, of bending the different arms and training them in an oblique direction is to check the too rapid motion of the sap upwards, and distribute the same amount of nourishment to the lower shoots as to the higher ones.

The arms of the vines are better tied up about the time the swollen buds are on the eve of bursting—according to localities, from the middle of August to the end of September—as the wood is then more pliant and more easy to bend into bows; whereas earlier in the season, during the winter, it is somewhat brittle and easily broken.

When no supports are used in training the vines, the arms are simply entwined in the shape of bows, or else one or more canes are bent down, lashed to the stock by means of a tie, and made into a loop.

With vines trained on stakes, the extremities of the canes are gathered on the top of the stake and made to bulge out a little, so as to leave an empty space in the centre for the free circulation of air and the access of sun and light to the green leaves as well as to the bunches of grapes.

Ties.—Amongst the best the cheapest are found the most efficient, and no money need be spent under this head on the vineyard. A few square yards of rushes grown in a swamp, a few rows of ozier willow (golden willow—*Salix alba*), planted close along a ditch bank and headed back to low pollards in the winter, or a patch of New Zealand flax (*Phormium tenax*), will supply suitable materials for tying the vines. For this purpose, the rushes, twigs of willows, or outer leaves of the New Zealand flax, are cut when green with a bill-hook or a sickle, dried in the shade, and stored in a damp place until wanted for tying the vines, or soaked in water previous to being used.

The canes should be tied to the stakes, the trellis, or the vine-trunks tightly enough to prevent chafing without compressing and cutting through the bark. In this operation, which, with a little experience, is very quickly done, the rushes, or willow twigs, are simply twisted round the grape-vine and its support, the thick end being twisted around the smaller two or three times and twined round towards the vine, which prevents it from untwisting itself. The strips of New Zealand flax are tied with a knot, and form a very good tie. Grape or reaping-machine twine, old ropes with the strands undone, and thin wires are also used as ties, but have the disadvantage of costing money. Strips of stringybark and wisps of rye-straw cut 12 to 18 inches long and softened in water are sometimes used with advantage.

Winter-ploughing

Should be commenced after pruning, and whenever the weather and the condition of the ground permit.

A short mould-board swing plough, of American pattern, will be found to answer the purpose of leaving the soil well pulverised, thus promoting the sweetening effect of the air on it. It also leaves bare the vine-stock, around which insects and weeds are more numerous, and makes it easier to cut off the suckers.

In a light soil and a cool climate, winter-ploughing need not be so deep as in a heavy soil, and in a hot district.* The share should penetrate 4 inches in the first instance, and 6 inches in the second. Another result of winter-ploughing is that it cuts off the tender feeding rootlets of the plant which grow close to the surface, and thus is the vine better able to withstand severe drought, or the too-sudden changes of the temperature of the soil, which, at blossoming-time, may have an injurious effect on the vine. Whenever the distance between the lines and the nature of the soil will allow, a double-furrow plough should be used in preference to a single-furrow one, as the cost of the operation will thereby be proportionately lessened; a three-furrow plough may even be recommended whenever the vines are planted very wide apart.

Summer Cultivation of the Soil,

Which nourishes the vine, is almost as indispensable as pruning is to the vine itself in raising a crop of grapes.

Small vineyards are almost ruined owing to complete disregard for two or three successive seasons of these two operations, which constitute two of the most essential requirements in the cultivation of the vine. The necessity of combining a thorough cultivation of the ground with a system of pruning suitable for any particular vine is, on the other hand, made very evident by the bountiful crop which a vineyard will yield if well cultivated. A vineyard that has half-perished through neglect may also be brought back to luxuriant growth under kindlier treatment and intelligent attention.

Some vine-growers rest satisfied after they have ridded the ground of the growth of thirsty weeds, whose roots rob the vines of their full share of the available plant-food.

Clean cultivation, however, is only one of the advantages of summer cultivation of the soil; it also acts in a variety of other ways in maintaining the soil in a condition favourable to the growth of the root system of the plant. Amongst these, far the most important are the retention of moisture in the ground; the opening up and sweetening of the soil by the atmospheric air; the fertilising action of that air on the particles of the soil; and also the more favourable condition it is in for absorbing moisture.

It should be so regulated as not to reach and tear off the principal roots of the plant, and must be deeper in hot and dry localities, where the growth of surface roots should not be encouraged; in no case, however, should it go further than 6 inches deep for the winter-ploughing, while in moist localities 4 inches is quite deep enough. The advantage of this ploughing is that it ensures the destruction of the rootlets which show a tendency of growing more profusely in the upper layer of the soil in search of moisture, and of any of the fertilisers that may have been spread between the vines. Were these feeding roots let alone they would soon take upon themselves the care of supplying nourishment to the plant, thus causing the withering and atrophy of the deeper-seated ones. The intense summer heat, however, and the working of the implements, by destroying and mangling a large portion of the superficial roots, would then cause a greater check to the growth of the plant that its deep roots are no longer in a state effectively to replace those of the surface.

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* These figures might be raised to 6 and 8 inches respectively.—M. B.

Implements used for Summer Cultivation.

A few words about a suitable implement for the purpose of summer cultivation will serve as a guide to the intending purchaser. It is with the cultivation of the soil as with any other handiwork, and the skilful husbandman will perform good work with an indifferent tool. Some implements, however, are more serviceable and more effective than others, and should in consequence command attention. Amongst these, a favourite implement for working the land between fruit-trees, vines, or any of our cultivated crop, and one of the best yet introduced, is the American steel scarifier, known as the *Planet Junior.* It combines all the essentials of a good agricultural implement; it is moderate in price, the cost of No. 6 Horse Hoe, with expanding and raising levers, being small. It is so light that a labourer can carry it from one field to another, while at the same time it is stronger, will last longer, and breaks up the ground in a way that few other implements will do. Another advantage worth considering is that its draught is very light, and by the adjustment of diamond-shaped tines and shares of different shapes it can in a few minutes be made ready for a variety of purposes. These tines and shares are bolted to the frame, and when worn out at one end can be reversed, while their initial cost is less than that of many other appliances. Excellent work has been done with this implement on land as gravelly as a metalled road, and in the autumn, although the scarifier had been kept steadily at work during a moist summer, the tines were almost as pointed and sharp in their outline as when it was bought. By the handling of a simple lever the width of the implement can be regulated from 18 inches to 4 feet without stopping the horse.

The scarifier should not be called into use simply for killing the weeds. It should also be run as soon as possible after a heavy shower of rain, which batters down the soil and forms a crust on the surface; for the same reason, wherever irrigation is practised the scarifier must follow. During the hot and dry summer months it should be run every four or five weeks, even though the soil is clean. In every case a light cultivation, about 3 inches deep, is preferable, if the land can be well pulverised, as the loosening the soil to a greater depth would result in too much evaporation, whereas the object sought for is simply to maintain over the water-conducting body of compact earth a relatively non-conducting layer of loose soil.

The cost of cultivation varies, of course, with the character of the soil; as a rule one man with one horse will scarify 3 acres a day.

INSECT AND FUNGOUS DISEASES.

Phylloxera.

Phylloxera-resistant stocks are recommended. Full particulars of this pest have appeared in the *Agricultural Gazette,* Vol. VI, p. 13, and reprints can be obtained on application to Department.

Caterpillars.

Spray with Paris Green 1lb., water 160 gallons, and a little soft soap to make it adhesive.

Oïdium.

Symptoms and Description.

The oïdium is a mould that grows exclusively on the outer or epidermic tissues of the vine, and attacks only the green organs of the plant, viz., young shoots, buds, leaves, tendrils, flowers, berries, and stalks. It at first appears as a dirty white sort of efflorescence, extending like a thin film, possessing a characteristic mouldy smell.

After the attacked wood has become ripe and hard, the imprints of oïdium may be seen as dark-brown patches on the surface of the bark, which is not gnawed through as in the case of "anthracnose" or "black spot." The wood is sometimes susceptible of ripening, but it is liable to dry up in the winter, and never should it be selected as either a cutting for planting or a scion for grafting.

Very often the invasion occurs after the blossoming, and in that case it mostly attacks the leaves and the bunches. Should it appear early, and unless proper attention is paid in due time, it will cause the flowers to abort.

The tender leaves are the first and the most seriously attacked, the disease showing preferably on the under surface. Its meshwork of microscopic threads or filaments spread round them, and they soon shrivel and dry up, while their full power as organs of evaporation and of assimilation of some of the constituents of the air is seriously impeded, and the must of grapes coming from attacked vines is never so rich as in the case of well-matured and healthy grapes.

It is the berry, however, that the parasite seems to most particularly cherish. The affected berries are either entirely or partially covered with a sort of whitish greasy powder, which at first can be rubbed off without leaving any trace, but which, after a few days, when the powdery mould has taken a greyish tint, leaves, on rubbing off, little black specks on the surface of the skin.

The effect of the parasite on the skin is to tighten it and prevent it from stretching, so that the berries either dry up or else burst open. The ripening does not progress satisfactorily; the berries assume a dull and sickly colour after they have turned, and, if crushed and fermented, produce a nasty wine with a mouldy taste and flavour, and indifferent keeping qualities.

Oïdium is found more prevalent in some districts than in others, and, as a rule, flourishes best in localities where the atmosphere is generally warm, moist, and muggy, while its attacks are not so serious in a hot and dry climate. In this country it has been found almost impossible to cultivate the vine in the North Coast District, and it is only by dint of sulphuring that bunches of grapes can be made to ripen at all in a zone extending for 15 to 20 miles along the coast, from the Hunter River down the South Coast. So unsuitable is the climate of the drier interior, on the other hand, to the spread of the pest that some vine-growers have never used sulphur at all, and except in occasional wet seasons hardly ever suffer from the attacks of oïdium.

Again, some varieties of vines are more affected by the disease, and to be acquainted with them enables the vine-grower to be better prepared for any possible invasion, and at the same time warns him to apply extra dressings of the specific powder to these particular varieties.

Varieties most attacked by Oïdium, and cultivated in Australia, are:—Albilio, Carignane, the Cabernets, Chasselas, Black Hamburgh, Gouais, the Muscats, Œillade, Pedro Ximenes, Riesling, Roussanne (White Hermitage), Shiraz (Black Hermitage), Tokay (Green Hungary), Trebbiano (Ugni blanc), Verdelho.

Varieties not much attacked:—Aramon, Dolcetto, Grenache (Roussillon), Mataro (Mourvèdre), Marsanne (White Shiraz), the Pinots (Burgundy), Sauvignon.

Varieties least attacked:—Malbeck, Catawba, and Isabella, two varieties of an American vine (*V. Labrusca*), and, in fact, most American vines.

Sulphur: A Cure for Oïdium.

All vine-growers are acquainted with oïdium, and a great majority know that sulphur is the specific remedy against the pest. A great many, however, may not be aware that there is a form under which sulphur is more active for that purpose, and also that the state of the weather and the time of day when the application is made have a direct influence upon the efficacy of the remedy.

Atmospheric conditions have a considerable influence over the growth of oïdium. A warm temperature favours its growth; but great heat, such as when the thermometer rises up to 95° F. (35° C.) stops the progress of the fungus, which actually dies out when the temperature reaches 113° F. (45° C.); though its débris, when the circumstances become favourable, soon cause a new invasion. It is often noticed, especially in warm districts, where the temperature close to the surface of the soil goes up very high, owing to the reflection of heat, that the lower leaves, as well as the bunches that hang pretty low, are often free from the disease, while on high trellises, under similar circumstances, it is seen to blight the vine and wither the crop.

Experiments repeatedly conducted in all parts of the world have conclusively demonstrated the specific action of sulphur against oïdium, and powdered sulphur, as well as flowers of sulphur, is now used for the disease.

It is not necessary, moreover, to bring the particles of sulphur into immediate contact with the spores (seeds) and fungus threads (*Mycelium* and *Hyphæ*) to effect their destruction, as the fumes which this substance in a fine condition emits at elevated temperatures, and especially by exposure to the sun and heat, are the only active agents of destruction of the mould. Under the action of this heat the sulphur is oxidised, and sulphurous acid is formed (the gas evolved when sulphur is burnt in the air), which is an efficient insecticide and mould-destroyer. That action, it has been noticed, is more pronounced when the sky is pure and without clouds than in diffused light.

The inference from these facts, therefore, is that sulphur is best applied when the temperature rises up to a minimum of 70° F. (21° C.) and over. In places where the temperature of the soil rises as high as 110° F. (43° C.), spreading the sulphur on the ground under the vines is sufficient to accomplish the destruction of the parasite, and that being about the temperature of the soil in December when the fruits are ripening, the spreading of the sulphur on the ground is sometimes resorted to as a means of preventing the roasting of the berries. It is a well-known fact that nurserymen often sprinkle powder of sulphur over the pipes of their hot-houses to destroy moulds and insects on their plants by means of the sulphurous acid fumes thus produced. The idea, therefore, that some people entertain, that sulphur acts by blocking the stomata or breathing-pores of the leaves, has little to rest upon. Of course a greater quantity must then be applied, but the sulphur is not altogether wasted, as it has been noticed that vines thus treated show a healthy and vigorous growth. The explanation is that sulphur acts in that instance—

1st. In warding off insects and moulds.

2nd. As a fertilising agent, being gradually turned in the ground into sulphuric acid, which, acting upon the mineral constituents of the soil, and notably the potash, prepares for the use of the plant soluble plant food within reach of the rootlets. Sulphur, in a word, is not only beneficial as a mould-destroyer on the vine, but it is also a tonic that stimulates the growth and the production of the plant, preventing the abortion of the flowers. It is a good practice to increase the dose of sulphur after a particularly heavy crop of grapes.

"Ground," "Sublimed," and "Precipitated" Sulphur.

The three forms are used with beneficial effects. Fumes of sulphur being the ultimate result in view, it is evident that the finer the sample of sulphur, the greater must be the surface exposed to the air, and consequently the more fumes will be given off. One of the best ways of testing sulphur when purchasing it for dressing either the grape or the hop vine is to submit it to a microscopic examination. Under a magnifying-glass, ground sulphur is in the form of very minute and separate crystals, like powder, whereas sublimed sulphur, or "flowers of sulphur," shows like small beads, either separate or two or three coarse particles soldered together, each bead having a diameter of 10 to 20 thousandths of a millimetre respectively. Precipitated sulphur, seen under the microscope, presents the aspect of little crystalline particles; each one is separate, the diameter of each minute little particle being only the 1 to 2 thousandth of a millimetre.

Anybody who has had any experience of the value of sulphur as a mould-destroyer, has recognised the fact that sulphur is the more efficacious when the powder is in a finer state of division, and almost impalpable to the touch. At least, such has been the observation of all practical men, and here again we find an instance of practice bearing out theory. Some brands of sulphur, such as the "Crown Brand," which, looked at under the microscope, are shown to be in a finer state of division than other brands, are likewise found more efficacious as a remedy against oïdium. As a rule, it may be stated that the finer the powdered sulphur the better it adheres to the leaves on which it is blown, the less it is liable to be shaken off by wind, and the greater the superficial surface it offers to the atmospheric air, which, under the influence of warmth, causes it to volatilise and enters with it into the state of combination which will attack and destroy the fungus.

The only drawback of precipitated sulphur is its higher price as compared with the other forms of powdered sulphur; but, on the other hand, it must be considered that a less quantity will go a longer way in checking oïdium, and, owing to the fact that large quantities are now extracted during the purifying process of gas, which, as it comes fresh from the retort, is impregnated with sulphurous acid and other deleterious impurities, its price is getting more reasonable and more within reach of the means of vine and fruit growers.

The three forms of sulphur just mentioned have precisely the same chemical composition, the only difference resting in their physical appearance as to colour, state of division, and the structure of their respective particles; thus, besides the difference as to shape and size given above, ground sulphur is easily distinguished from flowers of sulphur by its lighter tint of colour, while pure precipitated sulphur is of a light cream, and when extracted from coal gas is coloured by oxide of iron and other impurities.

In some parts of France it is the practice to mix the sulphur with soot and plaster of Paris, which, by reason of its dark colour, absorbs more readily the heat rays of the sun, and thus favours the giving off of the fumes from the sulphur. This mixture is also recommended for the last sulphuring, so as to save the grapes from being roasted by an excess of sulphurous acid gas given off at the time of the year when the air is intensely hot.

Time for Sulphuring.

Having discussed the destructive power of sulphur for oïdium, and the form most suitable for its application, a word of advice as to when and how best to apply it will be of value.

The sulphur should be used as a preventive against oïdium, and also, when necessary, as a curative for the pest.

The fact has come within the observation of every vine-grower that grapes which have been sulphured from three to five times at the right moment, and in favourable weather, can be made to ripen without a vestige of oïdium about them, while those which have been sulphured but once are sometimes infested with the mould, although to a lesser degree than those which have not been sulphured at all.

The most favourable hours for applying sulphur are from 8 a.m. till 4 p.m. before the time the berries have turned, and in the early morning or in the afternoon after the grapes have turned, so as to prevent roasting.

The sulphur, which is moistened by dew, does not give off its vapours until the water evaporates.

A shower following the application of sulphur does not affect its composition injuriously, but often renders the operation less profitable by washing the particles mechanically from the leaves.

A strong wind, likewise, does much damage in shaking off and removing the sulphur from the leaves, and a windy day should therefore be avoided for applying the remedy, as it aggravates the irritation to the eyes of the sulphurers.

In most cases in which sulphur, applied in the form of a very fine powder, has failed to check the progress of the oïdium, the failure may almost to a certainty be ascribed to one of these conditions having occurred or having been disregarded.

Sulphuring, to be efficacious, must be used as a preventive remedy. If it is delayed until the formation of the *perithecia* (fruits of the fungus) it is not likely to do much good, for, although it may destroy the mycelial threads, the *ascospores* (seeds of the fungus) are too well protected within their hard coverings to be injured by the application.*

The best times for sulphuring are :—

1st. Early in the spring, when the shoots are 4 inches long.

2nd. Just about the time of blossoming, as however well the application may have been made, it is almost certain that some of the *conidia* (terminal cells) of the mycelial threads, swollen and filled with a transparent granular matter (one of the forms of reproduction of the fungus), will escape destruction. These, with spores brought from other vineyards, may bring a new infection in about three to four weeks' time. At this period the blossoms may be rendered sterile by the threads of the oïdium covering the newly-expanded flowers, and causing them to abort.

3rd. A few days before the "turning" of the berries. In wet seasons, or in moist districts, as much as four or five, and sometimes six, sulphurings may be necessary, and no hard and fast rule can be laid down for each application. The vineyardist should use his own judgment, and sulphur more especially those varieties most subject to oïdium, until the pest has completely disappeared.

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* *Uncinula spiralis* has been discovered in some parts of America, but not in California The pest is especially perpetuated by the fragments of the *mycelium* and summer spores which escape destruction. The *perithecia* are able to pass the winter through the wall of their cell becoming thicker and harder.—M.B.

How best to apply Sulphur.

Many Australian vine-growers simply put the sulphur in a coarse bag, and walk along the lines shaking it over each vine. This method is exceedingly simple, but answers only in the case of young vines, and necessitates besides the use of a larger quantity of sulphur. It is difficult indeed to get at the under surface of the leaves by this means, and, moreover, the sulphur is not very evenly spread.

A dredging-box, made of tin and conical in shape, 8 or 10 inches high, is very useful for the first sulphuring, when the shoots are only a few inches long. The base is 3 to 4 inches wide, slightly convex, and pierced with a great number of small holes, like the rose of a small watering-can. A lid, about 2 inches in diameter, allows the sulphur to be introduced at the upper part. Inside, a little above the convex bottom, a coarse sieve pulverises the lumps of sulphur. An improvement on this dredging-box is the addition of a woollen tuft or piece of sheepskin, with the wool outside, attached to the bottom, which, like the dredger, is pierced with little holes. By this means the sulphur is more finely sprinkled, but the instrument is liable to get clogged through the woollen tuft getting wet by using on leaves still covered with dew.

The bellows are the most widely used utensils. Several models are in use, the simplest being the most effective. They are also superior to the dredging-box, in so far as sulphur is applied by their means with a certain force, and can be projected to the under surface of the leaves.

Two main weak points characterise a great many of the sulphur bellows now in use:—

1st. The sulphur chamber, which is filled up with the powder, is often placed at the further end of the instrument and between the bellows proper and the nozzle, thus making it heavier of handling by the operator.

2nd. In several patterns, the sulphur is placed direct in the bellows, which is made to serve as a receiving chamber as well, and is thus placed in direct contact with the leather, which soon perishes, owing to the action on it of the sulphuric acid, which is produced under the influence of heat and dampness on the sulphur. Bellows, with an independent reservoir placed close to the operator's hands, should therefore be preferred.

The workmen who sulphur the vines carry with them a canvas bag fastened in front of them, and capable of holding 8 or 10 lb. of sulphur. This bag is provided at one of its lower angles with a conical tin nozzle, closed by a cork stopper and intended to introduce the sulphur into the bellows.

The price of the bellows varies from 3s. to 5s. per pair.

Sulphuring Machines.

The "Torpedo" sulphurer and powder distributor, brought out by M. Vermorel, is a further improvement both on the pepper-box and the ordinary bellows, the only disadvantage being that in this Colony its price is still rather high. It consists (*vide Agricultural Gazette*, Part 10, Vol. II, p. 605) of a tin reservoir capable of holding about 20 lb. of powder, sufficient for dressing nearly 1 acre of vines. Like the "Sprayer," of the same maker, it is a knapsack apparatus, and is so constructed as to regulate the amount of powder it is intended distribute, while the machine cannot get choked.

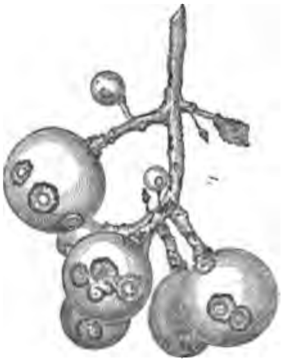
When at work, the reservoirs having, about an inch from the bottom, a piece of fine metallic wire gauze through which the sulphur is sifted, an air-pump directs a blast of wind on the sieve and carries the powder through a piece of india-rubber piping, terminated by a tin tube 3 feet in length or more, and having at its end a flattened circular piece of tin. The blast, after impact on the piece of tin, spreads the powder out in a fan-like shape, and distributes the sulphur evenly in the form of a cloud. The machine can be obtained in Sydney, and is easily kept in order, all that is required, besides the emptying of the reservoir after using, being an occasional oiling of such parts of the lever where friction occurs.

In the course of experiments made by Mr. Despeissis in conjunction with the Pathologist of the Department it was ascertained—

1. That this machine distributes powder more evenly and in a finer state of division than the ordinary bellows.
2. That to produce a similar effect less powder need be distributed by its means over a given area, thus effecting great economy.
3. That the powder is applied with more force, and has a better chance of adhering to all the leaves, while the effort of working is considerably less than when the ordinary bellows are used.

Anthracnose or "Black Spot" on Grape Vines.

This disease has been noticed in numerous vineyards in New South Wales. It appears on the leaves, stock, and berries, in the form of circular spots, which are at first minute and black, but which gradually increase in size till they exceed half an inch in diameter. Several such spots running together may produce larger irregular patches. At first the spots are mere points on the surface, but as they grow older and larger they become sunken, especially so on the stock. As soon as the spots reach a size of two lines across, or thereabouts, the centre becomes grey, or even white, owing to the fructification of the fungus which causes the disease. Experiments have convinced the Pathologist that under favourable conditions the white incrustations will, if sown on undiseased stems, give rise to new spots in seven days. The favourable condition necessary for this result is moisture, either in the form of damp weather, or heavy dews accompanied by skies so cloudy as to prevent quick evaporation in the morning. It will be readily seen that under such conditions the fungus is bound to increase rapidly, and to do much damage. Inasmuch as there are several diseases of the vine whose outward manifestation is the appearance of dark spots, it will be unsafe for a vine-grower to assume that any black spot he chances to see on his vines must be due to anthracnose. It will be best to have the disease pronounced upon by the Department. There is good reason to believe that our vine-growers are calling two distinct diseases by the same name, viz., "Black Spot." The following remedies are recommended:—



(1.) Cutting off and burning affected parts. This is thorough but expensive. It must be followed up season after season.

(2.) Dusting with a mixture of equal parts of lime and sulphur.

(3.) Spraying or swabbing once in the winter with concentrated solution of sulphate of iron, and following this up with a spray of Bordeaux mixture once in two to three weeks, beginning before the time of blossoming, and stopping when the grapes begin to ripen. No spray should be applied while the plants are in blossom, otherwise the flowers will be blasted, and the crop spoiled.

Applications of the Bordeaux mixture, if continued up to the time of ripening, sometimes leave the grapes somewhat soiled. This can be prevented by using as a final spray *Eau Céleste.*

The mixtures are composed as follows:—

Concentrated Solution of Sulphate of Iron.

For preparation see foot-note, page 379.

Bordeaux Mixture.

For preparation see page 340.

Eau Céleste.

Copper sulphate (bluestone)	1 lb.
Ammonia	1½ pint.
Water	22 gallons.

Dissolve the bluestone and add the ammonia.

Anthracnose or Black Spot is difficult to altogether eradicate, but that it can be effectively checked by treatment with No. 3, mentioned above, is the testimony of hundreds of vine-growers in various parts of Europe and America. The second season after the treatment is begun the disease is very much reduced—in some cases, practically exterminated. The amount applied to 1 acre of vines will vary from 22 to 36 gallons, according to the machine used and the dexterity of the operator. The cost, even in Australia, including labour, materials, and spraying machine, need not exceed one penny per vine for the season, if more than 2 to 3 acres are operated on, and as we develop the importation and manufacture of spraying machines may be reduced to half that sum. Thus it will be seen that vine-growers suffering much loss from this disease have a good chance to increase their profits.

Pourridié—Mouldy-root of the Vine.

This is a disease which occurs on the roots of vines growing in damp soil. In mild cases it occurs in small patches throughout the vineyard; and in such cases it will be found that the soil where the disease occurs is permanently damp. The occurrence of the disease is therefore a positive indication of one of two things,—either the soil is utterly unsuited to the vine, or the drainage is defective. The disease is more likely to occur on land newly cleared of forest than on land long reclaimed. In some parts of France pourridié kills as many vines as the phylloxera.

The appearance of vines suffering from mould on the roots, or pourridié, reminds one, in some degree, of the effects of phylloxera. The stock fails to produce healthy shoots, and the growth becomes stunted and irregular. A number of such stocks situated together produce an effect in the vineyard which is visible from a distance, as in the case of phylloxera, not only on account of the smallness of the vines, but also on account of their unhealthy colour. If the roots of such unhealthy-looking vines be examined, there is no difficulty in distinguishing between pourridié and phylloxera, for while, in the case of phylloxera, we find the roots attacked by numbers of small insects, in the case of pourridié we find them to be attacked by a white, grey, or brown mould or fungus. The mould, which at first is white, and ultimately changes through grey and brown to black, is composed of numerous microscopic filaments which are woven together into cords or ribbon-like structures, and these are applied closely to the bark of the vine-roots,—for it is at the expense of the bark and the wood of the vine that the fungus grows. Not infrequently, these cords, composed of fungus filaments, may be traced a considerable distance through the soil, and some of them are found to come to the surface of the ground in order to fructify, or, to put it plainly, though not very accurately, to "produce a toadstool."

Remedies.

1. The sovereign remedy for pourridié is good drainage. This disease never occurs in well-drained vineyards where the soil is otherwise suitable to the vine.
2. Pull out and burn all badly diseased vines.
3. Wherever the disease has appeared, apply lime liberally, and also other appropriate manures. This has the effect of sweetening the soil, and improving it in other ways. If a whole vineyard or a considerable area is to be treated, the soil should be thoroughly cultivated with other crops for two or three years; after that vines may be again planted.
4. In mild cases—that is, when the disease occurs in patches—it is not necessary to treat so drastically. First isolate the patch of diseased vines by means of a deep trench all round. Then pull out the worst of the vines and burn them, after which the roots of the vines less severely attacked should be laid bare, and the whole patch treated with lime. Cover up the treated roots and keep the soil well stirred.

THE CELLAR.

THE subject of wine-making and cellarage is so complicated that it is not possible in a work of this kind to spare the space necessary for elaborate treatment, and it is felt that, unless every operation is described to the minutest detail, the inexperienced vigneron would only be embarrassed.

Articles by the Viticultural Expert on the subject are now appearing in the *Agricultural Gazette*; and as soon as the series is complete, it is contemplated having them collected in pamphlet form for distribution to vignerons.

RAISIN-MAKING.

CONSIDERING the extraordinary natural advantages which this Colony possesses as regards dryness of climate, fertility of soil, and the suitability of a considerable area of country for the purpose of growing grapes for raisin-making, it is simply astounding that our enterprising farmers in the western and south-western districts should not as yet have added this profitable industry to their system of mixed farming. The advantages are evident and the returns highly remunerative. The demand, however, is limited, but still every pound of the £20,000 or £30,000 worth of raisins and currants imported annually into this Colony alone might, with much ease and profit, be produced here, thus saving to the country the exportation of a large sum of money, besides giving employment on the land to a large number of labourers. Moreover, it should be borne in mind that some of the best varieties of grapes for raisin-making, viz., Muscatel Gordo Blanco and its close parent, Muscat of Alexandria, are likewise the most suitable for exportation to distant European markets as fresh fruit; so that by planting them the grower would have the alternative of either selling them as table grapes, exporting them fresh, or making them into raisins, while the unmarketable bunches would still be valuable for the still.

Best Grapes for Raisins and Currants.

Muscatel Gordo Blanco stands easily first on the list of raisin grapes. It is very much like the Muscat of Alexandria, from which it is said to be a seedling, and differs from it by having a lower and more spreading growth, with closer bunches, rounder berries, covered with a thicker and finer bloom, which is more easily preserved during the processes of drying and packing than in the case of Muscats of Alexandria. Its other valuable characteristics are that it is a surer cropper than its parent, sets more freely, and is less subject to Anthracnose or Black Spot. It requires short pruning.

Seedless Sultana.—Much valued on account of the peculiarity which has given its name to the grape. When grown under favourable conditions it is a very heavy cropper, and is pruned long.

Zante and Corinth Currants.—Both requiring long pruning to bear a crop, and in South Australia, where they thrive well when planted on rich soil, they appear to do best when trained on trellises, and planted at a distance of 12 feet between the lines, and 24 feet in the rows. Between every two currant vines, three Muscat vines, pruned short and headed low, are planted at 6 feet apart. The currants are trellised about the fourth year, and taken over the tops of the raisin vines. For that purpose a 7-foot post is put at each currant vine. At the top of each post a cross-piece, 3 feet long, is bolted or nailed so as to form a T; a No. 10 steel wire is stretched at each end and another through the post, 1 foot from the top. Two long runners are trained along the lower wire, and the fruit shoots from it, tied up right and left alternately, to the two upper wires borne at the extremities of the cross-piece. In that way the currant vines will meet each other in two or three years, and can be kept quite clear of the Muscat vines growing beneath.

Muscats will give a good return the third year, while currants will not be in full bearing till the seventh or eighth year, but a crop will be picked the fifth.

Picking.—The grapes should never be picked for drying before they are dead ripe.

The currant crop is ready for picking a fortnight before the Muscats, and the same trays answer for drying both crops, so that the advantage of growing them together is evident.

There are several ways of ascertaining whether the crop is fully ripe:—

1st. By the colour, which, in the case of the Muscatel Gordo Blanco, should be a bright amber, and also by the taste.

2nd. By the saccharometer, which gives more accurate indications, as a bunch grown in the shade may be ripe and yet colourless. It is reckoned that the juice of the grape should contain at least 25 per cent. of grape sugar to produce a good raisin.

Great care should be taken in picking not to remove the bloom, which would spoil the appearance of the raisin. For that reason the bunch is handled by the stem, cut with a sharp knife, all imperfect berries, pieces of stalk, dead leaves removed, and then placed upon either shallow baskets or directly upon the trays right side up, *i.e.*, the side showing less of the stem. In large vineyards there is economy in placing the trays between the rows of vines and covering them at once with grapes, whereas on a small vineyard it may be convenient to take them all to the kiln or to the drying terrace.

Table Raisins

Are very easily dried. The finest bunches having been carefully picked, as described, they are simply put on wooden trays, made 2 feet wide and 3 feet long. If too large they are not so convenient to handle when filled. Each tray receives 20 lb. to 30 lb. of grapes, which should produce 6 lb. to 10 lb. of raisins after having been put out in the sun or in the kiln to dry.

Upon the state of the weather and the size and degree of ripeness of the berries will the time required for drying depend. Rapid drying gives a hard and tough raisin, and should be avoided. At the end of eight to fourteen days, according to circumstances, the grapes, being about two-thirds dry, are turned, by placing an empty tray on the top of a full one, and turning them over. A piece of board, 1½ inch to 2 inches high, is nailed at each end of the tray, so that there is always a clear space between them, and the berries are not crushed while turning, when, on the other hand, should the weather turn wet, or the dew be abundant at night, the trays can be stacked one upon another. After turning the drying will proceed more rapidly, and the raisins should be watched to prevent them from becoming too dry.

Sweat-box.—If the raisins on the trays are examined, some of them will be found dry enough, while some of them may be too dry, and some not sufficiently cured. At this stage the sweat-box is found useful for equalising the sample and making the stems tough and ready for packing. The sweat-boxes are 7 inches to 8 inches deep, and large enough to admit a tray easily. They contain 110 lb. to 120 lb. of raisins. When emptying the contents of the trays into the sweat-boxes all bunches which are insufficiently dry are placed on a fresh tray for further drying. A ready method of ascertaining whether the berries are sufficiently dry is to roll them gently between the thumb and the finger. If any liquid exudes at the stem end the raisins require further drying.

In transferring the contents of the trays into the sweat-box the raisins are slid off in the same position as when they lay on the tray; to prevent the stems getting entangled two sheets of Manilla paper of the size of the box are put in at intervals as the box is being filled. The sorters have two or three sweat-boxes, and grade the raisins into first, second, and third quality.

When the sweat-boxes are full they are put away, one on the top of another for ten or twelve days to sweat, after which they are taken to the packing room, which is provided with tables, scales, presses, and neat boxes of different size, holding 5 lb., 10 lb., 15 lb., and 20 lb., in layers of 5 lb. each.

Pudding Raisins

Are sometimes made of the same grape when loose and of inferior quality, and also of the Seedless Sultana.

For that purpose the grapes are picked when ripe, put into ozier baskets, and dipped for fifteen to twenty seconds in boiling lye, made of 1 lb. of potash or of washing soda, to 3 gallons of water; then plunged in fresh water for a rinsing, and afterwards placed on trays. The object of the dipping is to make the dry process more active, by dissolving or saponifying the waxy covering which constitute the bloom and opening up the pores of the skin, thereby allowing the moisture to escape more freely from the fruit.

The grapes are then placed on trays, put on a truck, which is wheeled for a few minutes into a small hut, which can be hermetically closed, and in which sulphur is burning. The sulphuring is done with a view of obtaining the well-known amber colour of the pudding raisins, which does not in any way improve its quality, but is merely done to comply with the demand of the market. From the sulphur chamber the raisins are dried either partially or entirely on the trays, and put through the stemmer and grader. The stemmer removes the berries from the stems, and the grader, by separating according to size, determines the grade.

Since the introduction of evaporators and kilns for drying fruits and raisins, the industry has been successfully and extensively carried out in districts which, owing to the uncertainty and the wetness of the seasons, would not permit of conducting the process of fruit-drying, simple as it is, in the open air. For the information of vine-growers who might be desirous of constructing a cheap and efficient drying-kiln, the following specification is submitted:—

Specification of Raisin-drying Kiln.

Drying kiln 50 feet long and 22 ft. 6 in. wide and 8 feet high. The dividing wall and the two side walls are of cob 18 inches thick. Cob is the surface soil and subsoil excavated from the site of the building, thoroughly wetted and worked together, then turned over and mixed with straw, and then built up as a wall. The two ends and furnaces are of brick. In each kiln there are two lengths of wrought-iron pipes 9 inches in diameter, with a furnace at each end. Thus the heat is equalised throughout, and there are racks on each side of the kiln, on which ten trays can be placed over each other, and ten trays in length. Thus in the two kilns 400 trays can be put in at a time.

The iron pipes are laid 2 feet below the floor. The foundations of all the walls are first dug out 2 ft. 3 in. deep, the cuttings filled in with concrete, made of gravel, broken stones, sand, and lime, to 3 inches above the surface for the centre and side walls. For the end walls start with brickwork from the bottom, so as to build two furnaces at each end and two flues for the furnaces at the opposite ends. Dig the centre out to the depth of the foundations, and build the wall with same. The pipes are 9 inches in diameter, made in 4-foot lengths, telescoped into one another, and laid in the bottom of the ground. Thus they are 2 ft. 3 in. in the plate, 2 ft. 5 in. below the joists carrying the floor, which consists of 6 x 1-in. boards laid roughly and nearly close together. The ceiling overhead is covered with 9 inches of mud cob, same as walls, over which is a galvanised-iron roof and a verandah.

The Dairy

Selection of Stock.

It is not possible in a work of this kind to give all the opinions that have been expressed concerning the points of dairy cattle, but even if it were, there is grave doubt as to whether the novice could profit much by them. The best advice that can be given to any one desirous of purchasing one or more cows for ordinary purposes is to either get the assistance of some really capable buyer, or to take every opportunity he can get to observe at shows and in ordinary dairy herds in his locality the type of animal that seems to thrive best under conditions somewhat akin to the provision he has for keeping a cow. Where specific advice is required the Dairy Expert to the Department, Mr. M. A. O'Callaghan, should be consulted.

For those who intend embarking in dairying on a large scale no better work can be recommended than "Practical Dairying for Australia." *

The book is obtainable at the Government Printing Office, Sydney, price 4s.

The various breeds of dairy cattle are now being fully treated by Mr. O'Callaghan in the *Agricultural Gazette*. The articles will be reprinted in pamphlet form, and can be obtained on application to the Department of Agriculture.

Following is a scale of points which embraces the opinions of many of the most successful breeders of dairy cattle in the South Coast District:—

DAIRY COW. (Maximum 125.)

Style and General Appearance.—5 points. Including quality, symmetry, and general proportion throughout.

Size.—5 points. About medium.

Colour.—5 points. Roan, red, or red and white preferred (in accordance with breed), the richer and more lustrous the better.

Head.—7 points. Fine square muzzle, lower jaw well developed, nostrils large and open, face fine and rather long, forehead fairly broad between eyes, but narrower on top; eyes large and full; with calm and mild expression; ears medium length, fine, and inside skin orange tinted, cheek and jaw flat and clean; horns may be fairly long, or short, but not coarse, and well set on.

Neck.—5 points. Medium length, fairly straight on top, and symmetrically set on shoulders, flat on sides, and free from fleshy development, fairly deep, but free from loose skin at throat.

Fore-quarter.—7 points. Fine, but sufficiently developed to ensure constitution, shoulders fine on top, joints of spine showing clearly, shoulder blades fine but not deeply covered with flesh, brisket light, but not projecting forward or down.

Back.—7 points. Straight, level, and uniform, fairly broad on loins and hips, and lower in front than at hind-quarters.

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* By Dowling and M'Caffrey, Department of Agriculture, Sydney, 1893.

Body.—12 points. Capacious, broad, and deep, especially behind, underline broad, with ample loose skin, ribs well sprung and wide apart, and running very deep behind, ample space between last rib and hip.

Flank.—5 points. Very deep and flat—that is, uniform to both body and thigh.

Udder.—20 points. Large, capacious, and well-formed, extending well forward and well up and broad behind, well out to flanks in front, broad behind, well proportioned and uniform underneath, *i.e.*, not forked or guttered, skin soft and orange-tinted, veins showing well throughout, when extended with milk free from knots or projecting lumps, when milked or dry soft and pliable, with ample loose skin.

Teats.—5 points. Hanging perpendicularly and well shaped, and set wide apart, not coarse or fleshy, tan colour, and about 3 inches in length.

Milk Vein.—5 points. Thick and irregular, turned well out on body, and well branched off.

Hind-quarters.—7 points. Long, level, and uniform from hip to pin, broad behind, and free from fleshy development.

Thighs.—5 points. Broad, deep, and flat, thin through, and set wide behind, inside clean, and free from superfluous flesh.

Escutcheon.—3 points. Well developed, and curling well out on thighs, and extending high up.

Legs.—5 points. Short in proportion to size, and fine, especially under the knee and hock ; joints neat and clean, feet well formed and neat, with good hoof.

Tail.—2 points. Well set on and fairly fine, extending well down to the hocks, and with good tuft.

Temper.—5 points. Quiet, docile, and tractable.

Skin.—10 points. Medium thickness, soft and pliable to the touch, hair soft and fine.

DAIRY BULL. (Maximum 110.)

Style and General Appearance.—5 points. Including quality, symmetry, and genera proportion throughout.

Colour.—5 points.

Head.—7 points. Fine but masculine, muzzle square, lower jaw well developed, nostrils large, eyes large and full, with calm, placid expression ; forehead fairly broad between eyes, narrower on top of head, cheek and jaw flat and clean ; ears fine, medium length, inside skin orange tinted ; horns strong, but not coarse.

Neck.—5 points. Fairly long, slightly arched, massive on top but fine underneath, and nearly connected with cheek and jaw, free from loose skin underneath.

Fore-quarter.—8 points. Fine, but fairly massive, shoulders well sloped and fine on top, joints of spine showing clearly; shoulder blades fine, but clearly defined, and free from superfluous fleshy covering ; brisket light, and not projecting much forward or downward.

Back.—8 points. Straight, level and uniform, loins and hips broad.

Body.—14 points. Capacious and deep, especially behind, underline broad, and skin loose and very pliable, ribs well sprung and running very deep behind, ample space between last rib and hip.

Flank.—5 points. Very deep and flat, that is, uniform to both body and thigh.

Hind-quarters.—8 points. Long, level, and uniform throughout from hip to pin, broad behind and wide between the pin and bones, and free from superfluous fleshy development.

Thighs.—5 points. Broad, deep, and flat, clean and fine inside, and free from superfluous fleshy development.

Legs.—5 points. Short in proportion to size, bone fine, especially under the knee and hock ; joints well formed, but neat and clean, feet neat and well set on.

Testes.—5 points. Large, even, and well developed, but not coarse, fairly long, and hanging perpendicularly.

Milk Vein.—3 points. Clearly defined, and well out on the body.

Teats.—3 points. Set wide apart.

Escutcheon.—2 points. Well developed, curling well out, and extending well up on the thighs.

Tail.—2 points. Well set on, and fairly fine, extending well down to hocks, and well tufted.

Temper.—5 points. Quiet, docile, and tractable.

Size.—5 points. Rather above medium size.

Skin.—10 points. Medium thickness, soft and pliable to the touch, hair soft and fine.

Mr. David Lindsay Dymock, of Jamberoo, who is regarded as one of the best judges of dairy stock in New South Wales, gives the following description of a good dairy cow:—

"Square and heavy behind, long from haunch to hip, wedge-shaped, light brisket, neck long and thin, full eyes, horns thin, intelligent looking, colour spotted or roan, well-defined milk veins prominent and tortuous on udder and belly; teats 3 or 4 inches apart, and hanging perpendicularly; should be of fair size and length, not funnel-shaped; deep flank; big round body, as this is the boiler power to produce all; escutcheon or mirror, well out on sides of flank to root of tail, as the arteries of the udder follow same."

Another method of judging the milking qualities of a cow is that known as the escutcheon principle. The system was founded in 1822 by Mons. François Guènon, while engaged as a lad minding cows in Lisbourné, France. In the illustration, which appeared in the *Agricultural Gazette*, from "Sheldon's Dairying," it will be observed that a considerable portion of the hair on the udder and thighs has an upward tendency, and also spreads outwards. This reversed hair is called the escutcheon, and Guènon believing that he could trace a relationship between the yield of milk and the escutcheon of cows spent many years in varying his observations. In 1828 the Academy of Bordeaux took the matter up and extensive experiments were conducted by a committee who reported that Guènon had established a method by means of which it was possible to class milch cows according to—

1. The quantity of milk they can yield;
2. The period during which they will continue to give milk;
3. The quality of their milk.

For full details of this system readers are referred to "Sheldon's Work on Dairying." It may be mentioned that the late Mr. Grierson, who for many years managed the Bodalla Estate, placed considerable faith in this method, and Mr. M. A. O'Callaghan, Dairy Expert to the Department, also believes in it.

No one should purchase a bull or cow without a guarantee as to the healthiness of the animal. Full particulars as to the tuberculin test have been published by the Department, and copies of Mr. O'Callaghan's article may be obtained on application.

Grasses and Fodder Crops.

The following extracts from "Practical Dairying for Australia," are really summaries of the methods that have proved most successful in all the dairying districts of the Colony:—

"*Grasses.*

"In dairy farming it is not the area of land a farmer owns so much as the quantity of grass per acre that can be grown each year. If a farmer has 100 acres of land and three-fourths of this land is covered with weeds and inferior grasses, it is impossible to expect anything but failure. If the substances or constituents are not in the soil it is impossible for the grass to take it out, hence the good grasses will disappear and inferior grasses and weeds will take their place. If the substance from which good butter and milk can be produced is not in the grasses or other foods it is impossible for the cow to give a profitable return.

"Those in search of farms can invariably be guided by the timber and class of undergrowth found growing on the land, especially the latter. It is of the greatest importance to have good soil. Experience has taught dairy farmers that it is much better to pay a reasonable rent for good land than to occupy bad land rent free.

"It has been said, with a considerable amount of truth, that ten cows well cared for are better than thirty cows neglected, but the fact must not be lost sight of that, if by a little extra care and attention the thirty cows can be properly cared for, they will be at least three times more profitable than ten cows. Dairy farmers found this out years ago, and, in order to maintain the greatest possible number of cows on, say, 100 acres, they divided the farms into convenient paddocks, and took one of these paddocks in hand with a twofold object in view. One was by a system of rotation of fodder crops to maintain and keep in good condition a greater number of milk cows than could otherwise be done off the pasture alone; the other was to get the soil in good condition by killing all weeds and bad grasses for laying it down with enduring nutritious grasses. In the meanwhile the other paddocks were improved by top-dressing with farm, or stockyard, or other suitable manures, to be afterwards sown with grass. These in turn, as found convenient, were ploughed up and treated in the same manner as paddock No. 1. By this means the farm was improved and periodically renewed with grass.

"It is at all times advisable to have a paddock or two closed so as to allow the grass to recuperate and produce seeds which can be saved and used on the farm.

"When grass is sown the soil should be in good condition after the autumn rains; the young grass has then time to develop before the hot sun in summer burns it out. Very often a thin crop of oats is sown with the young grass to protect it from the weather during the winter or early spring. Before grass is sown it is always advisable to harrow the ground level first, and soil worked to a fine bed, being well pulverised, then sow the seed on a calm day if possible, to insure an even distribution of the seed over the ground, then cover over lightly with a light harrow or bush drawn by two bullocks or one horse.

"*Fodder Crops.*

"No fast laws can be laid down for a system of providing fodder crops for hand-feeding cattle, nor the quantity or variety of these crops. In some districts the cattle require more hand fodder than others. And the fodder crops that are suitable in one district may not thrive well in another. The following system is generally adopted in a 12-acre paddock:—A species of the sorghum family is planted or sown in December or January, about 5 acres; more sugar is obtained from this fodder the easier and thinner it is sown. Three acres of maize sown broadcast in January or early in February. During March and April the remainder of the paddock may be laid down with the following crops:—**Oats, barley, rye, tares**; these latter crops often better mixed in proportions from one to three or half and half. Care must be exercised not to feed exclusively on sorghum or any food containing large quantities of saccharine matter, as it will ultimately injure the procreative powers of the stock, and render it difficult to get the cows in calf. This, of course, can be counteracted by having good grass paddocks for the cows to feed on, or feed alternately with other fodders. Lucerne, although not considered equal to other fodders for producing good flavoured butter, is nevertheless very productive, and forms the mainstay as fodder on many dairy farms in this Colony. Concentrated foods are generally condemned as being injurious to cattle, it being argued that cattle require a certain quantity of bulky food as being necessary for their health. At Bodalla, where high-class farming is the rule, the rotation is mainly hay after roots.* **Maize** is sown in October and November. When two crops of this cereal are taken off, the land is manured with farmyard manure or bone-dust; then a crop of tares, rye, and peas, mixed in equal proportions, two bushels per acre being sown by a broadcast seed-sower. This is used for ensilage, the crop sown in July being ready for the reaper and binder in December. **Beans** are sown in August and September. The land is prepared for these by deep ploughing and scarifying. The seed is sown by a corn-planter in drills 28 inches apart, half a bushel to the acre being sufficient. This crop is being cut for pig-food, a purpose for which it is very suitable. 'Horse' are found to be more profitable than 'broad' beans. About 45 bushels per acre is the yield. The **horse-tooth maize** is considered the best variety. The crop varies from 30 to 65 bushels per acre off new ground. The maize for the greater part is pulled; but some is fed off by pigs. Ninety-day maize is sown so as to come early for pig-feeding. The soil in many parts of the estate is remarkably rich, and this, coupled with a mild climate and a rainfall which averages 33 inches per annum, gives, in most instances, heavy crops—mangels, 60 tons per acre, the 'red' being the heaviest yielder, but yellow globe best for fodder. Potatoes, only grown for store use, give 7 tons per acre; onions, about 5 tons. One of the best crops for pig-food is rape; 9 lb. per acre, broadcasted in February, and fed to the pigs in May with a drink of whey each day. White American corn is the best for ensilage, as it carries more flag than other varieties. Planters' friend and Cape barley are used for green feed; but recent experiments have proved that better than these is the crop of **thousand-headed and Jersey kale.** Thousand-headed kale can be sown in spring, summer, or autumn, 3 lb. to the acre drilled in; drills 30 inches apart, thinned out with a hoe subsequently, so as to make 2 feet spaces. In four months it gives a crop 4 feet in height—food which is of the very best kind, and which is suitable for sheep, cattle, horses, or pigs. Next in order is **Drumhead cabbage**, much like kale, about 2 lb. to each acre. Both these crops require land of good quality, good tillage, and a little manure. Many South Coast dairy farmers are of opinion that maize is better for their requirements than sorghum or planters' friend, which, however, are excellent fodder crops, and can be sown from October to the end of January. Sorghum will require 12 lb. of seed to the acre sown broadcast. It gives more saccharine matter than planters' friend, and can be either cut or 'fed off.' Some farmers collect the seed, and then mow the stalks, which they cut into chaff. Planters' friend resists frost better than sorghum, and it is a reliable fodder crop."

For details as to ensilage, see p. 101.

It is a great mistake to suppose that cows can do without proper shelter. There is scarcely any animal that will so well repay a little attention and gentle treatment as a cow. A nice warm little three-sided shed, free from draughts and backed towards the prevailing rainy quarter, can be constructed of slabs or bark without very great trouble.

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* A good rotation is—grass land; (1) oats or barley; (2) roots (mangolds); (3) oats or wheat, or sorghum and maize; (4) grass.—M.A.O'C.

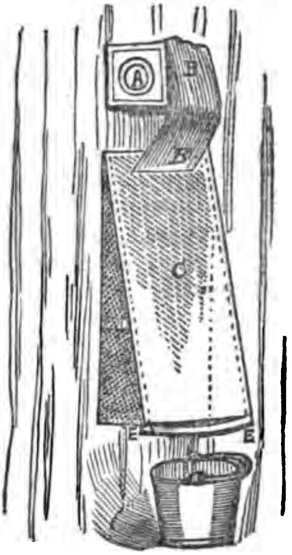
It is a common practice for persons inexperienced in the profitable management of dairy stock to "sool" the dogs on the cows when yarding or bailing them up. This is one of the most expensive bits of foolhardiness a man can indulge in. The cow, in her excitement and fear, will "hold back" her milk, and it is a curious thing that once a cow from any cause has "held back" she may continue the practice, to the ultimate ruin of her milk flow.

Of course, it is all very well to give advice on such matters, and everyone knows how provoking a refractory cow can be, but by keeping cool under such circumstances we are actually being paid for our forbearance.

The Dairy Building.

No matter how small may be the quantity of milk handled for butter or cheese-making, it is absolutely essential that provision should be made for a clean cool place as a dairy. It is scarcely possible to suggest a system of dairy construction that would be at once inexpensive and applicable to all the districts of the Colony. Much depends upon the material and capital available, and the beginner's own ingenuity, but as an instance of what can be done in the direction without great expenditure of either money or trouble, attention is invited to the following account of the method devised by a New Zealand farmer many years ago, and which, in the opinion of Messrs. Dowling and M'Caffrey, is one of the simplest plans that have been adopted:—

"I must first give you to understand that my dairy is not a grand stone structure, with flagged floor; neither is it built of brick, nor is it dug out of the side of a hill; but, though simply made of timber, of the board and batten type of construction, and attached to the back part of my house, I will venture to declare that it is one of the coolest, if not the coolest, dairies in the Kaipara. Having made this particularly bold assertion, I will now endeavour to show, for the benefit of any of your readers who may like to try my plan, how is it that I dare to do so. To begin with, I must explain that I have covered the roof with sods, cut about 8 inches thick, having, of course, first nailed on pieces of tin and zinc to prevent the boards from rotting. These sods I water with a syringe every other day, and I now have a nice crop of green grass growing, which effectually prevents the rays from the sun penetrating and heating the building as far as concerns the roof, which is the most important part to protect, as it receives the sun's rays at nearly a right angle during the hottest part of the day. At each end of my dairy I have a large opening or window, covered with perforated zinc to keep out flies and other insects, and at the same time to ensure a thorough draught. On the outside of these openings are stretched pieces of canvas nailed to tapering strips of wood, placed one on each side of the window. Above each window is fixed a kerosene tin, cut open on one side to allow of its being filled with water. In this receptacle I introduce one end of a piece of cloth, the other end hanging over the outside of the tin and touching the canvas blind to which it is sewn in order to prevent it blowing about with the wind. Along the bottom of each canvas blind is a strip of tin, bent so as to form a gutter, and under the lowest part of this gutter stands a bucket. The apparatus being thus completed, the kerosene tins are filled with water, which, being gradually absorbed and drawn up the cloth by the force known as capillary attraction, drips down on the outside and keeps the canvas blinds saturated with moisture. The evaporation from the film of water thus spread over the canvas covers produces cold, and the air, chilled by this means, enters the dairy through the perforated zinc. A kerosene tin filled with water, with cloth attached, will keep the canvas saturated for fifty hours without requiring any attention whatever, and at the end of that time all that is necessary to be done is to pour the water which has run into the buckets placed beneath the gutters back into the kerosene tins, adding, of course, the quantity lost by evaporation. By following the above instructions, anyone can secure a perfectly cool dairy or larder with very little trouble, and scarcely any appreciable expenditure. As a proof of the efficacy of the plan, I may say that I have kept meat perfectly fresh for five days during very hot weather.



Cooling the Dairy.

A. Kerosene tin. BB. Cloth, one end of which rests in water, the other on the canvas blind. C. Canvas blind. D. Tapering board to which blind is attached. EE. Gutter.

"This plan could be extended to any extent. The kerosene tins could be displaced by a larger reservoir, which could be fixed so as to supply several windows. Mr. J. L. Bruce, a very clever architect, when in a lecture on 'The Laws of Cooling,' took this simple plan for his keynote, and said:—'The suggestion and diagram are excellent, and the statements throughout scientifically reliable, as well as practical in the highest degree. The writer applies his notion only to his dairy, but it is of much wider application than that, and is suitable, with modifications, to every house in the colony. He cools the air going into his dairy, and absorbs heat from it out through the window as well as by the cooling or heat-absorbing effect of a canvas blind kept constantly moist by suitable means, which he describes. * * * Our dairy-cooling friend, however, uses and explains another means, to which I shall refer. He covered his dairy roof with turf, which he caused to grow with constant watering. Now this is a most ingenious idea, and combines within itself the obstruction of heat by an excellent non-conductor, and the abstraction of heat by an excellent evaporator. From experiments made on grass, bare earth, and water, by the Government Astronomer, it was proved that the evaporation during the year from grass was 20 per cent. greater than from bare earth, and only 14 per cent. less than from water itself; but when the grass was moist on the surface the evaporation was considerably in excess of that from water even, and so the cooling effect produced correspondingly great. So much for the excellent cooling effect of the turf covering. I do not think it is generally known that at a certain depth below the surface the temperature never varies throughout the year, but remains at the mean annual temperature of the locality. This depth is least at the tropics, and increases as the difference of summer and winter temperature enlarges. In England it is about 30 feet down, and here, from tests made at the Observatory, it is probably between 20 feet and 30 feet from the surface. Now the mean annual temperature here is a little over 63 degrees, and at this depth below the surface it is never hotter than that in summer and never colder in winter. We do not, however, require to go to this depth to derive very substantial cooling benefits from this material fact, for very small depths, indeed, produce most marked effects in reducing the variation of our surface temperatures. A box lowered to a depth of 19 feet in a dry well would keep its contents at a temperature which would never rise above 67 degrees or fall below 63 degrees, surely a point worth the trouble of lowering it down in a climate such as ours here in summer. This evaporation, then, is the most simple and inexpensive method of cooling, and one which can be applied in many ways.'"

This class of dairy is fast becoming a thing of the past, the separator takes its place. But a description of adobe buildings, which are cool, and can be constructed at slight expense, is given at page 204, Vol. 5, *Agricultural Gazette.*

The chief points for consideration in constructing a dairy are—

1. Perfect ventilation and dryness, with the maintenance of an even temperature in summer of from 56 to 60 degrees Fahr.
2. Absolute cleanliness and freedom from the source of all bad smells.

Limewash is a good purifier, and so is a bag of charcoal, but in the case of a cellar being utilised for dairying purposes, a box of air-slaked lime is one of the best means of overcoming ordinary dampness.

DAIRY NOTES.

By C. R. CASSIDY,

Dairy Instructor, Hawkesbury Agricultural College.

Milking.

It is a well-known fact that the flow of milk obtained from a cow depends very much upon the manner in which she is milked. There are several methods of milking. The squeezing method is no doubt the best when the teats are long and well developed, and for short teats stripping is the most suitable. There can be no objection raised against moistening the teats, provided that the udder and teats have first been well washed with water about blood heat, after washing dry with a cloth. The hands should not come in contact with the flow of milk. By means of moistening the teats the friction is greatly reduced. Whatever method is adopted by the milker, the operation should have a pleasing effect upon the cow.

Three very essential points in milking are quickness, quietness, and gentleness. A quick milker is seldom a bad one, and quick milking largely increases the milk-giving power of the cow. There should be no milk left in the udder, as doing so tends to dry up the milk, and these strippings are the richest portion of the milk.

If quietness is not maintained in the milking-shed, the cows become restless at any unusual noise, and in such a condition do not give a full flow of milk.

If the cow becomes excited or is harshly handled, she keeps the milk ducts closed by the muscles which control the outflow, and she will not give the milk she has secreted, besides she will secrete no more, and for this reason the person whose duty it is to milk should be on a friendly footing with the cow, and she should at all times be treated with kindness, as it is only under such treatment that a full and free flow of milk can be obtained. Out-of-door milking, if possible, is much the best, because cleanest. The food should be given before milking, so that they will feel contented, and stand patiently while being milked. The milkings should be about twelve hours apart, as near as possible; cows like regularity.

Treatment of Milk.

All utensils should be kept thoroughly clean. First wash in cold water; then hot steam and cool down. All strainers should be well washed and aired.

Milk readily absorbs any foul odour, and for this reason should be kept away from places which are likely to taint it. Calves and pigs should not be fed close to the dairy.

Aeration.—As soon as possible after the milk is drawn from the cow it should be aired. The aeration of milk removes the peculiar odour imparted to it by the cow. If this animal taint or odour is not removed while the milk is warm it becomes fixed, and in this way is one of the common taints in cheese-making.

Pasteurising.—After well aerating the milk it should be pasteurised, which will give it a better keeping quality, at the same time remove to a large degree taints of foods such as turnips, cabbages, &c. Pasteurising has the advantage of enabling the butter-maker to bring about an even and uniform quality of butter which possesses all the points that it is possible to find in butter of gilt-edge quality, but if the milk is being prepared for cheese-making it should not be pasteurised.

Quality of Milk and How Affected.

As a rule a cow gives most milk, but of the poorest quality, the first month or two of her lactation, and towards the end of her milking period the quantity shrinks, but the quality increases.

The food has a very decided effect upon the quality of butter and cheese produced from the milk. Some foods yield a soft butter wanting in flavour and body; others give good flavour and body; while for cheese-making some foods produce more solids in the milk, and yield a curd of a much firmer and of a superior class to other foods.

Why it is necessary to keep the Dairy Sweet and Clean.

Milk readily absorbs taints from dirty strainers, dirty cans, buckets, bad drains, &c. For this reason it is necessary to keep every portion and article in the dairy clean, and by such means lessen the danger of tainted milk-butter and other dairy produce. The person who is working the milk should be neat and clean about his work. Any whey, milk, &c., spilt about the floor will, if not at once cleaned up, form a breeding ground for bacteria which may be of an injurious nature, and when once they gain a footing in a dairy are not easily got rid of.

Butter-making.

Treatment of Cream.—As soon as the cream is separated, cool it down as low as possible, to 50 degrees Fah., if you can, and when required to ripen, raise the temperature of the cream to 65 degrees Fah., at which temperature it should ripen in from eighteen to twenty-four hours; when sufficiently ripened, cool down to 53 degrees Fah., before placing the cream in the churn.

Ripe cream has a granular lopid appearance, and is slightly sourish to the taste and smell. The granules may be seen by pouring the cream from one vessel into another.

Preparing the Churn.—The churn should be prepared by first scalding out with boiling water. Boiling water has the advantage of searching into the open crevices in the churn, and bringing into a liquid condition any grease that may be there, and carries it off before the wood has time to close over it; run hot water off and use two lots of cold, so as to ensure the churn being thoroughly cooled down, and at the same time carries away any grease that may be left by the hot water. All wooden utensils should be treated in the same way, sprinkling salt over worker and pats which should be well rubbed in to prevent the butter sticking.

Churning.—Place cream in churn, and, if necessary, add colouring. Commence churning at the speed proved to be the best in practice, which speed depends upon the make of churn, temperature, and condition of the cream, there being no rule of thumb method on which to work. Under varying conditions the butter-maker has a more thorough knowledge of the ability of a churn than the maker of the churn. To ensure an exhaustive churning of the cream, the speed should be such that the butter is not allowed to come quicker than half-an-hour after commencing. If while churning, the cream becomes too thick to properly circulate, add cold water to cause the cream to circulate sufficiently, but take care that the cream is not made too thin.

When the granules form about the size of pin heads, stop churning and wash down all cream from sides of churn with water about 45 to 50 degrees Fah.; then start churn and churn on until the granules are about the size of No. 5 shot. At this stage stop churn, this being the best condition of the butter for washing and salting; run off butter-milk, and pour in water in such a manner that it will lift the butter upon its surface; to prevent any danger of brusing the grain rather more water than amount of butter-milk removed should be added. Two or three washings may be needed, but avoid over washing because it destroys the flavour of the butter. After properly washing, drain off the water, weigh butter, and place on worker, taking care to keep it in a granular form; let it drain for a little while, then add ½ oz. of salt for immediate use, and ¾ of an oz. per lb. of butter for export purposes, making an allowance for the amount of moisture drained off; this can easily be judged after a little practice. Spread the salt evenly over the surface of the butter, and work sufficiently to thoroughly work the salt through the butter, and at the same time do not compress the grains more than can be avoided. Remove butter to draining-table, where it should be left for a few hours to allow salt to dissolve, so that the salt can be thoroughly worked through the butter. Again place on worker and work sufficiently to compress the grains, and remove any white streaks which may appear.

Packing the Butter.—The butter is now ready for packing, which should be done, if for export, in 56-lb. boxes lined with vegetable parchment made for that purpose. In packing take care no spaces are left for air or moisture, and use the packer in a pressing manner, not as a rammer. A large quantity of good butter is spoilt with bad packing. Butter properly packed when a core is taken out should be firm and solid throughout, and have an even appearance, showing no streaks nor specks, and when broken should show a surface like a piece of broken sandstone or cast-steel. All boxes should be neatly branded and finished off. The appearance of the package has a great influence in the selling of the butter.

Colouring:—The colouring should be added to the cream as soon as it is put into the churn.

The colouring of butter is largely done to please the consumer, but beyond this it has another use—that of bringing the butter produced in different districts to a uniform colour. In some districts the butter, due to the food and largely to the breed of cows, is of a deep yellow, while in other parts the natural colour of the butter is very pale, and in order to make the latter butter of the same rich colour as the former it would be necessary to use colouring matter. The quantity of colouring to be used in order to maintain a uniform colour in the butter varies according to the kind of colouring matter, kind of food, season, breed of cows, and length of time cows have been in milk. If good colouring is used no harm will result from its use.

Cream Separators.

The use of the separator is now so well known, and the various machines can be obtained at reasonable prices, it is found most profitable for a man with, say, ten milking cows, to purchase a hand separator rather than use the old method of setting to obtain the cream from the milk.

A few of the many advantages of separator cream and butter are that a larger yield of cream is obtained from the separator, and this of a superior quality to that obtained from set milk, also the butter is of a more uniform quality.

The cream should be ripened on the lines given in butter notes, and when ready for the churn add sufficient ice to the cream to bring temperature of cream down to 53 degrees Fah. If ice cannot be obtained the churning should be done in the cool early part of the morning.

CHEESE-MAKING ON THE CANADIAN CHEDDAR PRINCIPLE.

As practised at the Hawkesbury Agricultural College.

THE following is a concise statement of the way that the Cheddar cheese, which has proved to be so successful in the English and Colonial markets, is made at this institution. It is selling readily at 8d. per lb. for parcels over 1 cwt., and 9d. per lb. for parcels under that quantity. With so many apprentices manufacturing the cheese, it is of wonderful uniformity, quality, texture, and flavour, although occasionally, owing to that cause, a cheese may be found hardly up to the usual standard. It will be readily understood that no written description can ever make anyone a proficient cheesemaker, practice alone in this case can make one perfect, but at the same time it is desirable that the main principles as here laid down by Mr. C. R. Cassidy, the dairy instructor, may afford some idea of the lines on which to work:—

Aerate the milk, then set the evening's milk so as to be at a temperature not under 58 degrees Fahr., nor above 68 degrees in the morning. Skim off the cream of the evening's milk, and through a strainer pour into the vat the morning's milk, which will dissolve all the cream. Heat up the whole mass to 84 degrees in five to ten minutes, stirring with the rake meanwhile, so as to thoroughly mix the morning and evening milk. Take out 5 oz. of milk, and add one teaspoonful of rennet, stir rapidly for five seconds, and then slowly until it thickens. If the milk is sufficienly ripened, and the rennet (Hansen's) is of the proper strength, the 5 oz. of milk should coagulate in about twenty seconds. If the milk takes longer than twenty seconds to coagulate, it is better to delay setting or adding the rennet until the twenty-second test is satisfactory. Keep the milk in the vat at 84 degrees meanwhile. If, on the other hand, the milk shows a test of less than twenty seconds, the milk is over-ripe or turning sour, therefore add the colouring and rennet as soon as possible.

When ready, add 1½ to 2 oz. colouring to 100 gallons milk. Stir the milk well. Then add about 3 oz. rennet to 100 gallons milk; stir for five minutes; then work the scotch hand over the surface of the milk until it begins to thicken. Take notice of the time required for same—if the milk takes twelve minutes to thicken, it will take twice twelve and half of twelve, viz., thirty minutes, before it is ready to cut, from the time of adding the rennet. When ready to cut, commence with the vertical knife first, lengthways across the vat. In from five to ten minutes, cut with the horizontal knife, lengthways with vat only, and once across each end, taking great care not to knock the curd about. It is best to use the vertical knife first, as the cut strips are able to support themselves, and the downward pressure causes the whey to ooze out. When the horizontal knife is used first the layers press upon each other, and greatly retard the escape of whey.

After cutting, wash down all curd that may be adhering to the sides of the vat, and stir very gently with the hands for about ten minutes. Then stir with the rake very gently at first, so as not to bruise the curd. Heat slowly up to 98 degrees in from forty to fifty minutes, raising the temperature not more than 2 degrees in the first ten minutes. When the curd begins to get firmer, increase the speed of raking, so that at 89 to 91 degrees full speed is obtained. Continue raking vigorously until sufficient acidity is developed, at which stage the curd should feel firm, and squeak between the teeth. When ready, the whey turns a little sour or acid, and the curd will draw from ⅛ to ¼ inch on a hot iron, string-like hairs being noticeable. Run off the whey immediately by a syphon, and place the curd on a drainer, gently stirring with the hands in the meantime, so as to drain off the whey. Then pack the curd at one end of the drainer from 4 to 6 inches deep, well covered. In ten minutes cut the curd in strips from 10 to 12 inches long, 4 to 5 inches wide, turn them upside down, and turn every ten minutes until cheddared, which can be detected by the hairs drawing 1 inch on a hot iron; cut with the curd-cutter, and work the curd with the hands for about ten minutes. This aërates the curd and allows gas, &c., to escape. At this stage the curd should have a shining velvety appearance, when it is ready to salt. Use 2¼ lb. salt to 100 gallons milk, and again work the curd with the hands, so as to thoroughly salt it. Pack again for about ten minutes, and put the curd into the hoop at a temperature as near 80 degrees as possible. Place the hoop and its contents in the press, using little or no pressure for the first five or ten minutes. Then press gently until all the whey ceases to drip out. In about twenty minutes from the time of hooping use full pressure. In summer, twenty-four hours pressing is necessary, and forty-eight hours in winter. Then remove to curing-room, paste down the ends, and turn every day until disposed of. The curing-room should be as near 65 degrees as possible.

The Pig.

By J. L. THOMPSON,
Travelling Instructor in Agriculture.

There is no branch of farm husbandry that deserves so much attention by the farmer as pig-breeding, and the conditions under which the industry can be carried on are entirely favourable. The pig likes a temperate climate, and even in hot weather will put on flesh at an amazing rate if allowed plenty of room, fresh air, and suitable food. In this colony we have not to contend with the severe winters, the excessive frosts, and snowstorms of the old country and many of the states of America and Canada; and as it consequently takes less food to keep up the animal heat in our temperate climate, greater results under good management can be obtained from a given quantity of food.

The best kind of Pig.

In selecting sows, they need not all necessarily be pure breds, but should have a good dash of the Berkshire breed in them. They should be roomy, lengthy, well-shaped, and, for breeding purposes, with at least twelve teats.

They should be put to a well-bred Berkshire boar. It is imperative that the sire should in all cases be pure bred. As pigs are liable to degenerate from in-breeding, new blood may be introduced periodically with advantage.

The Tamworth boar will also produce good results from such sows. The young will mature early and give a fine mixed quality of flesh—lean and fat.

I, however, prefer the improved Berkshire to all other breeds, although the Poland China, Large White Yorkshire (cool climate), and Essex breeds will give good results under close attention.

The Form of a Good Pig of any Breed.

The aim of all breeders of animals designed solely for meat—be they bullocks, sheep, or pigs—is to have the body as nearly as possible filling the four squares of a rectangle. In proportion to the size, an animal of this shape contains the greatest weight. Hence, inexperienced people are often deceived with the weight of these compact square animals, as compared with the old-fashioned ill-formed pig of much greater apparent size. Another advantage of the square form is that it gives a much greater proportion of the most valuable parts of the pig—namely, the hams and shoulders. Many people object to the improved breeds because they are too short; but they appear short because they are so broad. A minimum of bone and a maximum of flesh are the desiderata necessary for a good profitable pig. No animal will give a better return for the care and food bestowed upon it than the pig. The weight of the stomach, in proportion to each 100 lb. of live weight is—in the ox, 3 lb.; sheep, 3½ lb.; fat pig, 0·66 lb. This shows that the stomach of an ox or sheep, in proportion to live weight, is about five times as great as that of the pig. But, although the stomach is small, the intestines are *capacious*, and this enables the pig to eat, digest, and assimilate more nutriment in a given time, in proportion to his size, than any other of our domestic animals.

The Points of a Good Pig.

		Points.
1.	Head wide in front, ears erect and pointed forward	6
2.	Chest wide and rising well to the shoulders, shoulder blades well sloped backwards	6
3.	Ribs well sprung, loins wide and slightly arched	10
4.	Hind quarters not to slope nor narrow towards the tail ...	10
5.	Hams well let down and full at the twist	12
6.	Chest wide, with elbows well out	10
7.	Fore-ribs wide underneath, flanks well let down and straight...	12
8.	Legs straight and small in the bone, feet small and compact ...	10
9.	Hair plentiful, bright, and vigorous	10
10.	Tail thick at root, and tapering to a fine point	4
11.	Size (according to breed) should be medium; extremes are undesirable...	10
	Perfection	100

The Profitable Management of Pigs.

I maintain that with our mild, comparatively temperate climate, pigs can be more profitably kept in these colonies than in any part of the world. One thing is necessary to bring this about, viz., to so arrange the keeping and feeding of pigs as to be able to realise a maximum of profitable results from a minimum of expenditure, and to have things so arranged as to be able to feed and attend properly to their wants without the employment of much labour.

First, then, the old system of keeping pigs in dirty small styes has exploded. Styes are only necessary during the time a sow has a litter, and on such occasions she should be got into it about a week before this important event takes place. The stye should be a fair size—say, 6 x 10—and the sleeping portion should have a wooden floor composed of red gum slabs or other cheap material. This is necessary, as pigs are often given to cramp and rheumatism at time of parturition and while suckling their young. At all other times the breeding sows should have access to a little lucerne paddock. Shelter, of course, must be provided alike from the excessive heat of the sun and the bleak cold wet weather in winter. This shelter-shed need not be an expensive structure. The system I have adopted is cheap, and cannot be said to be unsightly. Timber from the bush is simply used, and the roof is composed of straw, topped well up, and thatched. It serves for the two paddocks—the dividing fence between the two paddocks being in the centre. The area of the paddocks is 2½ acres each. The shelter-shed is 14 x 33 feet, and with the ten styes the whole is capable of keeping over a hundred pigs. The old theory was that before you could fatten a hog you had to close him up in a small stye. I have proved that a hog will put on more flesh, and, moreover, that of a more healthy and better description, if allowed reasonable exercise. A pig fed in a stye, especially in the summer time, without the means of getting exercise, has a tendency to generate a sort of blubber and lard, whereas a pig who has his liberty and the means of taking exercise produces meat of the firm streaky nature so much appreciated by all lovers of a slice of bacon. The public of to-day are a lean-eating public; they accept fat at a discount. The object, therefore, should be to produce meat that will be appreciated by the great majority of the people. The cost of the whole of the piggery at Hawkesbury Agricultural College did not exceed £200, and those going in for economy need not even go to that expense, as the fence round the enclosure need not be so strong, and four barb wires properly divided to a height of 3 feet will keep in almost any pig. The fence at the farm has two rails, as I think these rails give it a substantial appearance.

Size of Timber.—The posts are 5 ft. 6 in. long, 8 x 4. Rails, 9 ft. long, 8 x 2½.

Position of Rails and Wires.—1st barb wire, 3 inches from the ground; top of first rail, 13½ inches from the ground; 2nd barb wire, 17½ inches from the ground; top of second rail, 3 feet from the ground. Should it be found necessary, another barb wire could be put along the tops of the posts, thus making the fence 6 inches higher; but I have never had any pigs that would jump over the fence. I would draw particular attention to the position of the first barb wire, viz., 3 inches from the ground. This prevents the pigs from rooting and making holes at the bottom, which sometimes will admit of them getting out. With the barb wire so placed, however, the pigs will be glad to let rooting alone in that quarter.

Description of College Piggery.

Constructed of wood, on log foundations, walls being framed together, of round posts and sawn rails, and covered with upright 6 in. x 1 in. sawn boarding. Its dimensions are about 120 ft. long x 34 ft. wide, the width being divided into three parts, the centre 10 ft. wide x 10 ft. high on walls forming the passage way between the row of styes on each side. There is a pitched roof over the passage-way, and the roof over the styes is a lean-to on each side, about 2 ft. lower than the eaves of the centre roof, and falling to about 5 ft. high on the outer walls. The space on the centre walls between the roofs is filled in with rough lattice work for ventilation. At one end of the building are two rooms 12 ft. x 10 ft. for storing feed, &c., and at each end of the passage way are picket gates. The styes are divided into two compartments each of 6 ft. x 6 ft., the front one in the passage having the trough and door; the back one same size for bedding. The petitions are also of upright boarding, the cross ones having open slots 1 in. wide cut out on bottom ends of boards to give free ventilation over the floors. Round the walls of the bedding stye a guard-rail is fixed at about 8 in. from floor and wall for the protection of the suckers, and on the outer walls at each stye a pivoted door is arranged to allow the pigs to pass out and in as they like. The troughs are of wood lined with galvanized flat iron, dished half round on bottom, and stand about 9 in. high. Over the centre of each is a pivot-hung flap shutter, with sliding batten fastener on outside. This batten is so attached that it also serves as a handle. The flap can be fixed either to leave the trough free to the pig or to the attendant, so that it can be cleaned and refilled. The floors throughout are of wood, and laid with falls to centre drains under the division walls, which empty on to open gutters running down each side of the building, and then in pipes to manure pit. Water is laid on in pipes and taps in centre passage way. The outer walls and floors are well coated with tar, and the roofs (iron) with Gibson's roof-cooling paint.

[Of course, it is understood that the farmer keeping a few pigs could scarcely go in for a piggery on this scale, but the description is given so as to afford an idea of what is really the most economical style of building; and there is no reason why a little piggery could not be constructed on the same principle.—Ed.]

Feeding.

A pig should not be purchased until we are sure of a proper supply of nourishing food. In a climate like that of this Colony, food of the right sort could be grown all the year round. In winter, cabbage, thousand-headed kale, vetches, green barley, and odd crops, can, with intelligent cultivation, be produced in abundance. In summer you can produce maize, sorghum, peas, pumpkins, and all sorts of crops, for nothing that is wholesome comes amiss to a pig. Like the silo, he is the farmer's "save-all," and no farm is complete without its piggery, that will return more for the little trouble and systematic care that the inmates will need than almost any other branch of the holding. Above all, keep your pigs clean, and feed them with unfailing regularity. One day's neglect through want of food, or being compelled to spend a cold night in a wet, dirty, miserable stye, will counteract the work of a full week's careful attention. Give a pig a nice clean bed of straw and a chance to go outside to evacuate, and you will find that the straw in the sleeping sheds will remain clean for as long as a fortnight. The merits of cooked and raw food are an open question. A proportion of each is found to produce the best results. The ration should always be mixed—say with a few handfuls of bran or pollard to dry it up a little. Too much "swill" retards fattening. For young pigs, no single food equals milk, and nothing is better than milk for making superior pork from mature animals. The milk will, in nearly all cases, be fed to best advantage by the admixture of a little pollard for young pigs and maize-meal for mature hogs. Maize and like starchy or sugary foods ought to be reserved for the process of finishing off mature animals, unless mixed with foods richer in nitrogen.

Salt for Pigs.

Lumps of salt should be placed within the reach of all pigs, and a little sulphur mixed with their food will have a beneficial effect. They are also extremely fond of charcoal and coal cinders, and they will even eat coal itself; this assists digestion. Pigs should also be supplied with pure fresh water, and the water-trough should be frequently cleaned out. If cleanliness, plenty of fresh air, clean water, regularity of feeding, and shelter are attended to, you will not be troubled with much disease or death among your pigs.

Breeding Sows.

A sow may be put to the boar when eight months old, thus having young ones when a year old; but breeding from immature animals has a tendency to degenerate the race, and, all things considered, it is better to allow the female to be twelve months old before being put to the boar. The period of gestation in the sow is sixteen weeks, and a sow will generally have two litters each year. She will take the boar two or three days after farrowing; but if she had a good sized litter, it is undesirable to allow her to mate at this time, and as a rule she will not be in season again until the young ones are weaned—say at six or seven weeks old. If, however, the sow overlie her pigs and there be only a small number left, she should be put to the boar at the first opportunity in order to save time. During the time the sow is giving milk she should have abundance of good strengthening milk-giving food. Kitchen slops, crushed oats, or other corn will prove very beneficial at this time, and will have a good effect upon the young ones. At three weeks old the young pigs will also commence to eat a little food. If the litter is large, a small suitable trough should be provided for the young pigs, and this can be so arranged that the old sow cannot get into it, and a little milk or strengthening solids can thus be supplied to the youngsters.

As I mentioned before, about a week before the sow is expected to farrow she should be put into a clean fairly-roomy stye. It is not a good plan to have a large quantity of long straw in the stye when the little pigs come; we have often lost young pigs from this cause, as they sometimes crawl into it unseen by the mother, and she often unconsciously lies down upon them and smothers them. The straw should be like rough chaff, and not more than 3 inches deep when she pigs. A good plan is to put clean dry straw into the stye about a week before the event is likely to take place. If the wet portions are removed every morning the balance will be nicely cut up by the sow herself and trodden down; even with the bed prepared as stated, some clumsy sows overlie their pigs and kill many of them.

Castration.

The males not intended to be kept for boars should be castrated when about a month old, so as to be thoroughly recovered before they are weaned. The operation of castration is so simple that anyone can perform it, and it need not be explained here.

Ringing Pigs.

This operation is performed in order to counteract the propensity swine have to dig and furrow up the earth. Several American inventions have been introduced for this purpose, a great improvement on the horse-nail system. Pigs in young should never be rung, as the operation often causes abortion. Even the best rings often come out, and a better mode of proceeding is, when the pigs are young, to cut through the cartilage into the proper nasal. The divided edges of the cartilage will never unite again, and the snout always remains powerless.

HAM AND BACON CURING.

A PIG that is to be killed should be kept without food for twelve or sixteen hours. When the pigs are large, I find it best to shoot them with a bullet on the forehead—this prevents all squealing or exciting the other pigs. The shot pig will immediately drop, and can be stuck thoroughly with a long knife in a slanting direction towards the heart. Every effort should be made to get every drop of blood out of the body, otherwise the carcass will not cure so well. The pig is next immersed in nearly boiling water. The proper temperature of the water is very important. If either too hot or too cold, the hair will not come freely off. A good old-fashioned plan to try the temperature is to let a few drops of the pig's blood drop into the water; if it spreads all over the surface the temperature is right. Leave the pig in the water until the hair comes off freely. Pigs are not easily lifted out of the water, especially when hot, and it is a good plan to erect a block overhead, so as to facilitate this operation. The pig should now be vigorously scraped with a blunt instrument. There is nothing better for the purpose than the lid of an old billy. When the hair is all removed, the skin should be well dried. The internals are then removed in the usual way, and the inside wiped dry with a clean cloth. The pig should then be allowed to hang in a clean airy place for twenty-four hours. It is then cut up into hams, hands, spare-ribs, loins, and belly pieces. The spare-ribs and loins are generally used for roasting fresh. The other portions are rubbed over with coarse salt and a little saltpetre, and laid on a table, flesh uppermost, so as to drain off any blood.

Drysalting.

The system of dry-salting is to be recommended, as by this system the bacon is not so flabby as is the case when steeped in brine. To make good bacon by the dry process, equal quantities of best Liverpool salt and brown sugar are used, with ¼ oz. of saltpetre to each pound of the mixture. This thoroughly rubbed into the pork every second day, and the position of the meat changed at each rubbing—that is, put the top portions at the bottom, and *vice versa*. The time required for finishing the bacon will depend upon the size of the pig and the state of the weather. The salt goes into the meat more quickly in wet than in dry weather. The place for curing should be cool, with a free circulation of air. Ventilation is equally necessary for live creatures and dead meat. From three to four weeks will be required for the curing of a good-sized hog.

Brine-curing.

For brine-curing three tanks or tubs are necessary. Those at the College are built of brick and cemented.

Dissolve "Black Horse" brand Liverpool coarse salt in water until the liquid is strong enough to float a potato. To every gallon of this liquid add:—

¼ lb. sal prunella
¼ lb. saltpetre.
4 lb. brown sugar.

Dissolve thoroughly; add ½ lb. whole spice to every gallon (sewing the spice in a cotton bag to prevent it mixing with the pickle).

Boil the pickle for an hour; when cold it is ready for use. This pickle can be kept in constant use if it is boiled every two months, and replenished with spice, sugar, &c. Boiling causes all blood, fat, &c., to rise to the surface, when such matters can be easily skimmed off.

Pickle, properly looked after, becomes stronger and more valuable with age, and will last a long time.

The pork must be cold, or it will not take the salt properly. The colder the flesh the easier it is to cure, proving the advantages of a refrigerator.

Pump pickle into the shoulders and hams—from two to four injections in the shoulder, and two to three in the hams, according to their size.

Have bacon tank No. 1 empty. Cover bottom of tank with a thin layer of salt, then place a layer of bacon, taking care, should any of the sides overlie each other, to put a sprinkling of salt between. Sprinkle salt all over the pork, and also sprinkle very lightly with saltpetre; then pack another layer of bacon crossways upon the first, and so on until all the bacon is in tank. When packing the tank, keep every layer as nearly level as possible. Batten the meat firmly down, and cover the whole with pickle. If using new pickle, add one pound of brown sugar to every ten sides, dissolving it in the pickle before use.

Miss one whole day before turning the bacon into No. 2 tank, viz.:—Bacon put into No. 1 tank on Monday should be turned into No. 2 tank on Wednesday, and into No. 3 on Friday. The bacon will be ready to take out of pickle on Monday, giving it seven days in tanks.

Use saltpetre in No. 1 tank only.

Stacking.—Mark off part of the floor for stacking the bacon upon as it comes from tanks. Cover the space with salt; then put a layer of bacon, covering it with a light coat of salt; then another layer of bacon crosswise to the first, and so on, taking care to have layers level, and as much pressure on the pumped parts as possible. For the first fortnight turn the stacks twice a week, and once a week for the other two or three weeks. The bacon can then be washed and smoked, or hung up in the green state (unwashed) until required.

Hams when cut from the side.

Keep tanks and pickle for hams only. Follow instructions as given for bacon, with the addition of rubbing the face of every ham with brown sugar before covering with salt and saltpetre. After seven days take hams out of tanks and rub brown sugar over their faces; place them singly in rows, resting on a support to keep them level; then salt. For this purpose a room should be set apart, and drained into a small well in the floor, as the pickle that comes from the hams is worth keeping.

Leave the hams in the sugar-room one week. Go round them every morning and cover any bare patches with salt and sugar.

Take the hams from the sugar-room, brush them with a dandy brush to remove any slime that may have appeared on them, and stack them two deep in salt. The third week stack them three deep, and the fourth week four deep. After the fourth week build them into a square stack and turn it every week for four weeks, giving the hams a good pressing.

When washed and soft they can easily be batted into shape.

The hams are now ready for washing and smoking. Use ham pickle for pumping.

Smoking Bacon.

In our old-world experience bacon was generally smoked in the chimney, but this is an unsatisfactory way of doing it, especially in this country, and a bacon smoking-house is very easily constructed. A hut about 8 feet square, composed of bush timber, with strong beams across the top to hang the flitch upon. The flitches can be hung as close together as not to touch. The roof may be nearly flat, with only a very small opening to let out a portion of the smoke. The floor is then covered over with about 6 inches of hardwood sawdust, and this is lighted at two different sides. It will burn, but not cause any flame to injure the bacon. The door must be kept closed. About ten days will be required to properly smoke the bacon, after which it may be packed away in sawdust or bran until required for use. Sugar is now much employed in equal proportions with salt, and its use imparts a fine rich flavour to the meat. Of course there are many little things in connection with the killing of pigs that can be utilised by the thrifty house-wife, such as the lard, the head, sausages, while odds and ends can be used for pork pies, &c., &c.

LARD.

THE best quality of lard is obtained from the abdominal fat of the animal; the intestinal fat, trimmings, and refuse, yield an inferior quality.

It melts at 78° to 88° Fahr., and if perfectly pure has no tendency to become rancid; but there is generally sufficient impurity present to develop a change in the olein of the fat, which gradually exhibits itself by a yellow colour and rancid odour and taste.

On a large scale it is "rendered" in vats heated by coils of steam pipes, the waste matter being used for making dog-biscuits, &c.

The yield is sometimes 30 lb. to 50 lb. per pig, or even more.

On a small scale it is conveniently rendered in a water bath over a fire as follows:—Take two billypots (say 6 and 8 quarts capacity respectively, or any convenient sizes); put the small one inside the large one, and pass a piece of straight fencing-wire through all four handle-holes to keep the inner billy in its place; fill the outer larger billy with water, to within 6 inches of the top; put the fat to be rendered in the inner billy; raise the temperature of the water sufficiently to thoroughly liquefy the fat, and strain into bladders or clean tins. If desired, the liquid fat may be washed by stirring it into cold water, allowing it to stand over-night; by morning the fat will have all risen to surface of the water and solidified. The crust of fat may best be taken off by loosening it round the edges, and placing a clean board, the shape of the cake of fat, on its surface, and turning the whole upside down; the water runs away, and it will be found that a certain amount of discoloured matter will rest on the (original) under side of the crust; this can be removed, and the remainder will be very pure and clean.

By this system the risk of burning, and thus spoiling, the lard is practically done away with.

The trade in lard is an extensive one. A large amount is used in domestic cookery and by chemists, and good, pure, native-made lard commands a ready sale at remunerative rates.

DISEASES.

PIGS showing signs of sickness should be separated from the herd, as many swine diseases are contagious.

It is not easy to dose pigs, but much can be done by coaxing the animals to take medicine in drinks and mashes. An old shoe with the toe cut out can be used as a dosing appliance. Secure the pig by a rope attached to the leg, and cause him to snap at the shoe, and when he catches hold of it, pour in the dose.

One of the most serious complaints is inflammation of the lungs, called "pants" or "heaving or rising of the lights." Dullness, fever, loss of appetite, and a cough are noticeable. Bleeding from the brachial or plate vein, which is inside the foreleg just above the knee—a tight ligature being placed around the limb above the cut being previously applied—is recommended. Take a pint of blood before removing the ligature, and give an aperient dose of Epsom salts and half a drachm of sulphur. Keep the patient in a dry, fairly warm place, free from draughts, and in the event of recovery, dispose of that pig as soon as possible. Never breed from a sow that has doubtful lungs.

Looseness of the bowel can be treated with warm, starchy, gruels; colic by small doses of castor oil and ginger; mange by sulphur ointment and cooling medicines; worms, turpentine in doses of about ½-oz. in gruel.

	DOSE.
Epsom Salts	½ oz. to 2 oz.
Sulphur	½ oz. to 1½ oz.
Ginger	1 scruple to 1 drachm.
Croton Oil	1 to 3 drops.
Castor Oil...	½ to 2 oz.
Jalap	1 scruple to ½ drachm.

These notes are compiled from "The Pig" and "Practical Dairying."

Poultry Keeping on Farms.*

THIS article is not intended for giving help or instruction in the management of a poultry farm on a large scale, but to show how poultry keeping might be added as an auxiliary to general farming—a subsidiary that can be conducted by the wife or children of the household.

In poultry breeding the objects which should be kept in constant view are the production of eggs for local consumption and exportation, and table birds for home trade and foreign markets. Farms nearest the city or market towns will have the greatest advantages. The produce of the farm, under such circumstances, can be transported more frequently, with greater regularity, in better condition, and can be disposed of with greater facility. New-laid eggs and young table birds are always in demand. If these can be supplied with a certain regularity, and at known intervals, hotel-keepers and private families will become as interested in purchasing as the producer is in the selling.

It is a mistake to imagine that any kind of soil is suitable for a poultry run. A wet run is one of the greatest drawbacks we know of, and is the cause of nine-tenths of diseases that fowls are heir to, besides being the principal factor in checking the early production of eggs, which, of course, means late chickens. Choose a well-drained site, having a sandy loam soil, as near the house as convenient.

Varieties of Fowls to add to Farm Stock.

An egg farm is highly remunerative, especially so if a good supply can be depended upon during winter months. For this purpose the non-sitting breeds are the ones that should be chosen. Black Spanish, Andalusian, Minorcas, the various breeds of Leghorns, and also the Hamburgs, have their advocates as being amongst the best layers. Black Spanish lay a large egg, but are spring and summer layers. As a rule, the large comb races of non-sitters lay the largest eggs, and during the year may be said to lay the greater weight. In point of number the Hamburg races carry the palm. Two hundred eggs a year is not an uncommon production. The eggs of the spangled and pencilled varieties are small, but the black lays a fair-sized, marketable egg. Young birds lay early, and the older they are the later in season do they commence laying. The Hamburgs are not "all round birds." Being small in body, they do not make an acceptable table bird. If the principal part of the income is to be derived from eggs, this will not be a drawback.

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* Compiled from articles by Sam. Gray, Albert Gale, and other writers in *Agricultural Gazette.*

In current issues of the *Gazette* Mr. J. J. M'Cue is dealing with poultry-raising generally, while Mr. Geo. Bradshaw is devoting special attention to the requirements of the poultry export trade. Copies of the articles may be had on application.

Another point is that the layers must be a breed that produces chickens easily reared. Success in the nursery department is all-important. Whatever other quality they possess, the feathers must be light in colour. There is no greater drawback to the sale of dressed poultry than dark stub feathers showing under the skin. Utility, and not fancy, should be the motto of the poultry farmer. There will be always in a well-managed egg farm plenty of table birds to be disposed of, because the greatest production of eggs will be during the first laying season. When the layers are from fifteen to twenty months' old they should be discarded for egg purposes and prepared for the table. If the hens are of an early maturing breed, and have been highly fed and stimulated for egg production, it is a waste of time and feed to attempt to prepare them for a second season's laying.

As an egg producer the White Leghorn ranks highly. We do not mean the fancy or show birds. Birds with excess of points, so dear to the fancier, have no advantage over their less fortunate compeers as egg producers. Long, sweeping, sickle feathers, clearness of colour, excess in wattles and comb, is no advantage in the egg farm, although hens with large combs, as a rule, lay large eggs.

One of the first considerations is to ascertain the variety of fowls best suited to local conditions. In almost every district of the Colony there is some one who makes poultry-keeping a hobby, and while, like all such persons, he will probably have some particular "fancy," ten minutes' conversation will enable the intending poultry-keeper to ascertain what variety will suit him best. There are laying breeds, table breeds, and breeds which, to a fair extent, combine both qualities. The beginner is strongly advised to keep at first one breed only, and in the event of success not more than two. Fanciers keep many, but they do so simply to supply customers with any variety required. If an export trade for table birds is to be catered for, the choice at present is somewhat restricted, as the English market requires a white-legged, white-skinned bird. This trade should be attempted only east of the mountains, as it is not advisable to add a heavy land carriage to the cost of transport.

Roughly speaking, the laying breeds are Minorcas, Leghorns, Andalusians, Black Spanish, and Hamburgs. The table breeds are Australian Games, Indian Games, Brahmas, Cochins, and crosses. The general purpose breeds—Dorkings, Houdans, Langshans, Plymouth Rocks, Wyandottes, and Orpingtons. For the farmer who has a few ordinary hens we recommend the purchase of either an Australian or Indian Game, Dorking, or a Houdan rooster. He will find the resulting chicks a great improvement on the old breed, and a still further cross between the old rooster and his pullets will grade them upwards wonderfully. After this a fresh unrelated rooster should be purchased and the old one disposed of.

The thing for the poultry-keeper to consider is what he has the best market for, table birds or eggs. He must be guided entirely by local conditions. He can select his birds from those named. If he has already weedy birds running on his farm, he should get rid of them as speedily as possible (such birds are not worth the waste food they eat), either by a thorough clearance or the introduction of new blood. This may be accomplished in one of the two following ways, *i.e.*, eggs from pure-bred birds, or old birds themselves. If the former, No. 1 sitting of eggs from one poultry-fancier, and No. 2 from another breeder. Of course both sittings should be of the same breed. The chickens from these should be kept for stock purposes. One or two of the best roosters from No. 1 sitting should be kept to run with the pullets from No. 2 sitting of eggs, and the roosters from No. 2 sitting with the pullets from No. 1. If it be decided to keep some of the old weedy stock (hens only), all surplus roosters from the sittings can be turned in with them. The other way, and the cheaper in the long run, is to purchase a trio (cock and two hens) of maturing birds of the breed required. The rooster should be selected from the yard of one breeder, and the hens from that of another.

Housing.

Having decided upon the breed, make preparations for housing them. There should be a roosting-house and a wire run, so the birds can be confined at pleasure. The roosting-place is, of course, the most important. It is not well to build too big a house to commence with, so we will put it at 6 ft. x 6 ft., with a height of 6 feet at the apex, and a 6-inch fall, so that the front will be 5 ft. 6 in. high. The floor should be well-rammed earth. The house may be built of any timber available, and, while in most districts only three sides are necessary, with the open part facing east, the sides and roof should be air and water tight. Air will never hurt the birds, but a draught will cause disease and death. Sufficient perching space should be provided, all on the same level, and about 2 feet from the ground. It is a mistake to have them too high.* Under the perches some dry pulverised soil, not less than 3 inches deep, should be littered. This will prevent disagreeable effluvia, and catch the droppings which should be removed frequently, and carefully kept. They form a valuable manure for the garden when well rotted. The dry contaminating soil in the house should be frequently, according to the number of fowls housed, replaced. In a separate house make up the nests. These may consist of boxes without the tops and bottoms, placed on the floor along the wall. The litter may be either dry leaves, straw, fern leaves, or chaff, but only enough of either to keep the hen off the ground—she likes to sink down out of sight—and some kind of insect destroyer should be added.† The run may be any size convenient, and built of wire and posts, or saplings fixed close with a wire front. If the small breeds are kept the run must be wired over the top, as they are mostly great flyers. The inside of the roosting-house, together with all roosts and nest-boxes, should be thoroughly lime-washed to commence with, and the operation be repeated periodically, say once a fortnight in hot weather, and once a month in cold. Build additional houses as the stock increases; overcrowding is objectionable. Each run must be provided with water, which must be kept in the shade, and often replenished. A sheet of bark, supported about 30 inches from the ground, will be found useful; under it can also be placed a box half filled with dry earth, or wood ashes, for a dust-bath, in which the birds can cleanse themselves. It is a good plan to train some kind of a creeping plant over the run, so the birds can have plenty of shade in the hot weather.

The runs should be built on an easterly slope. For the first season the house already erected can be utilised as a breeding pen, but after that pens built as required, side by side. Eventually they may not only make an imposing show, but, being close together, can be worked more economically—an important point in poultry-keeping.

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* All roosts must be firmly fastened to prevent them falling.

† A small bit of camphor about the size of a marble will keep out all insect pests.

Feeding.

The first important matter is feeding. Birds which are allowed perfect freedom should have two regular meals daily. In the morning feed as early as possible. The food should consist of the scraps from the house-meals of the previous day, mixed with a little pollard and water, or skim milk. Mix thoroughly, and the mixture should be of such a consistency that on being dropped it will crumble. Soft food, when wet and sloppy, is unwholesome. Not more should be given than can be eaten. In winter, the morning meal should be warm. In the evening, about an hour before the birds go to roost, give them a feed of wheat, varied with barley, maize, or oats, the latter being preferable in cold weather. When the birds have free range they get all the green food required, but in confinement it is necessary to provide it for them. Chopped green clover is excellent. A good plan is to hang up a head of cabbage or a bundle of lettuces sufficiently high to necessitate the birds reaching up for it. It is a great mistake to throw green food on the ground, as it gets trampled and dirty, and most of it wasted—often left decaying on the ground, and most unwholesome for the birds to eat. In cold weather it is a good plan to throw a few handfuls of grain amongst some straw or waste chaff under a shed, where the fowls can scratch, and so promote circulation. This is of great assistance in keeping them in health, and consequently profitable. Cooked meat, and at times a little minced raw meat is good for laying hens.

With warmth and proper attention young birds can be kept laying during the winter months. It is of importance that the eggs should be collected daily, and placed in an egg-crate or a box containing bran or chaff, end downwards, and turned daily. On no account leave the eggs in the nest overnight. Irregularity in collecting eggs leads to loss of chickens in the clutch, and often offends customers.

With the above food-treatment and young birds, a supply of eggs may be obtained throughout the year. Before every meal wash all the vessels used as food dishes for the birds. If there is not running water near by of easy access, cool clean water must be supplied; it is in constant demand by laying birds. Lay an egg, leave the nest, and walk cackling for a drink is a rule with every laying hen. For an artificial supply of water, a stone fountain should be used; if kept in a shady place the water will be always cool and refreshing for the birds.

The Season to Breed.

The season for breeding must be controlled by the climatic conditions of the particular locality, but in any case the earlier the chicks are brought out the better. The setting of the first clutches should be so regulated that by the time the chicks are hatched the season will have sufficiently advanced to ensure their getting sun with enough power to warm them during the middle of the day—say from 10 a.m. to 3 p.m. The best egg-producing breeds are non-sitters, and this point must be considered in deciding on the breed to be kept. It is, however, a very simple matter to get hens which will do the necessary incubation and help to bring up the necessary chickens.

Hatching.

In the raising of large numbers of fowls incubators are of advantage. They require considerable experience and constant attention, but there are some self-regulating machines now on the market that can be used by the novice. Still for beginners, &c., we recommend the use of hens or hen turkeys, the latter for choice, as they cover a larger number of eggs. Their period of incubation is longer, there is more chance of constant sitting, and they make very careful and attentive mothers. They will easily cover from eighteen to twenty hen-eggs, and will continue reliable for five or six years. The best kind of nest is made by scooping out a circular indentation in the ground, and providing a litter of dry leaves or chaff; a little powdered sulphur, carbolic, or camphor, sprinkled through the nest will keep off vermin. In ordinary weather the hens coming off daily will get their breast feathers damp in the grass, and thus provide the moisture required during incubation. In very dry weather, however, the eggs should be sprinkled with warm wate about three days before they are due to hatch. The average time fo hatching the eggs of the different kinds of poultry is:—

Ordinary fowls	21 days.
Ducks	28 days.
Turkeys	26 to 29 days.
Geese	30 days.

Stale and newly-laid eggs should not be placed in the same nest together; the hatching is too irregular, and hens frequently trample the backward chickens to death.

Rearing the Chickens.

Chickens do not require any food until twelve hours after they are hatched. The first few meals should consist of hard-boiled eggs, bread crumbs, and oatmeal mixed with very little milk or water, so as to be almost dry and crumbly. After this feed on pollard, barley meal, or boiled potatoes with a little bran mixed through. In all cases scald it with milk or water, the former being preferable. Animal food and bone meal should be mixed through the food twice a week. For the first few weeks care must be taken to keep the chickens in dry situations. As age increases the young birds must be fed on wheat or maize crushed, but the morning meal must invariably consist of soft food scalded, and given as early as possible whilst warm. With a turkey hen the chicks may be allowed to roam at will after the first three or four days, as the turkey mothers move very slowly and carefully, and do not tire the chicks, as is the case with most ordinary hens. Always keep ordinary hen mothers in a coop (which must be shifted daily to fresh ground), placed in a nice sunny position, for at least a week. By this means the chicks can rest whenever they feel disposed to do so, and have gained considerable strength before the hen is at liberty to call them after her from daylight till sunset. Artificial mothers now in common use have many advantages. The young are under constant observation, and, if hatched under a hen, placed in it even before they are dry, will be kept free from vermin. Every hen leaves her brood with more or less vermin as a legacy.

As soon as the chicks are old enough to leave the mother, and the sexes can be distinguished, the cockerels should be placed by themselves in a roomy yard. Here they must be regularly fed until about ten days before they are required for market, when the number intended to be sold should be placed apart and fed in accordance with the fattening directions. This system should commence when the birds are about four to five months old, and the whole of them should be cleared out as soon as possible, or they will eat their heads off.

Most of the pullets should be kept for laying purposes, and will not require fattening; but any in excess of the number required for laying should be fattened and disposed of in the same manner as described for cockerels.

Laying Hens.

The stud rooster must be kept apart from the hens and pullets until the next breeding season. By this means he will be in far better health and condition than if running with them all the year through. The hens, though not so contented, will lay equally well without his attentions; and, what is perhaps still more important, the eggs being sterile, will keep much longer and be better in every way for household use and exportation. It is most important that hens have access to lime, in order to form hard shells to the eggs. Laying hens must be kept in healthy, active condition, and on no account be allowed to become fat. The signs of health are a bright red comb and wattles, clear bright eye, and glossy, well kept feathers. The healthy laying hen will be found always on the move scratching and picking up tasty morsels to assist egg production. When a hen becomes broody and her services are not required in that direction, she should be placed apart in a coop with a smooth bottom. The coop should then be slightly tilted from behind, so that she can find no comfortable place to sit. Two or three days confinement in this manner, with liberal feeding and plenty of fresh water will soon restore her to the laying yard, and she will be glad to get back to her companions. As the cold weather approaches steps must be taken to make the roosting house warm and comfortable, and, as already indicated, the morning meal should be warm, the hens should be induced to increased activity by throwing a little oats amongst some straw, and the evening meal should occasionally consist of cracked or small whole corn (maize). This will add considerably to their comfort and help to keep up the egg supply. Of course the birds vary much in regard to laying, but it will be found that as the old hens are taking a rest the early pullets will commence, and as they slow off some of the old hens will recommence, so that with a fair-sized flock of birds of mixed ages eggs will always be available. Let no ordinary hen live more than two years at the most.

The Second and following Seasons.

The processes above described have brought us round to the time to prepare for the second season's breeding. If the male bird is an exceptionally good one, which can be judged by the young stock, he should be placed in a breeding-pen with the original hens and about four of the pullets; if he has too many hens, many eggs will be sterile. Another pen should be made up of a newly-purchased cock in his second season, and six more of the pullets, and so on as required. The number of pens necessary to meet requirements must, of course, be fixed according to the market, of which some idea will have been obtained from the first season's sales of chicks and eggs. We would not, however, advise too many birds to begin with, as a few well looked after will be much more profitable than a large number neglected. Each pen should have a distinguishing letter or number, and the eggs should be marked with the letter or number of the pen from which they are taken, with the date if they are required for stock purposes. It is a good plan also to keep a book in which to record the make-up of the pen, the number of eggs set, and the number of chicks produced from each pen. The benefit of this will be appreciated when making up the pens for future breedings. It will perhaps be well to give a few hints which will guide the beginner in his future work. It is assumed that we have made up two pens on the lines indicated above, so that for the third season we shall have two stock male birds and the product of two pens. In making up the third season's pens the original cock should be penned off with pullets from pen No. 2, while the cock which was purchased last season can be mated to the two hens and some pullets of pen No. 1. If a third pen is required a cockerel from pen No. 2 can be mated to the two old hens from No. 1 and No. 2 cock have his number made up with pullets from pen No. 1. For future breedings the original cock must be disposed of, and a new one obtained of a different strain, when the system can be continued on the lines laid down. It will thus be seen that new blood will be continuously brought into the flock which will, therefore, be kept both large and healthy.

Table Breeds.

*"It is generally admitted that the essentials of a table-bird are quick maturity, large size, and excess of meat over bone and offal. Further than this, the proportion of white or breast meat is certainly a point for consideration. Before proceeding to detail a few of the breeds which can be confidently recommended for table purposes, I shall take the liberty of again impressing on my readers the fact that hardiness, and consequent early maturity, are more often to be found amongst well-bred stock, and further, that well-bred stock possessing such attributes cost actually less to feed and rear than mongrel birds, the stamina in which has been allowed to diminish by in-breeding and general neglect. Many of the well-known breeds are noted for hardiness, and the general robust health of the chicks enables them to take their food freely, and assimilate it rapidly, this being the only secret of quick maturity.

"I must confess strong bias in favour of the larger breeds for table birds. A miserable rat of a bird on a large dish has anything but an appetising appearance. Taking the quantity and quality of breast meat as a chief essential in a table-bird, I know of no breed which surpasses the game, and therefore claim this breed as the most valuable for that purpose. Moreover, games are notorious for their hardiness, and consequent easiness to rear. I have often heard it remarked that games are 'all legs and neck,' but the simple holding up of a game in one hand and some other breed in the other will quickly dispel such delusion. Careful inspection of this favourite breed will disclose the fact that the heart-shaped body is the very ideal of a table-bird, and no intelligent person, who has had the pleasure of carving and partaking of a well-developed eight-month cockerell, will hesitate to support my opinion. Next on the list comes the Plymouth Rock, which possesses a wealth of white juicy breast meat. This bird is hardy, and matures quickly, and I have it on the authority of a very successful New South Wales breeder that cockerels of his strain constantly weigh 5 lb. at four months old. I shall place third in the list the silver-grey English Dorking, and must again express surprise at the limited number of friends this bird has secured in Australia. In England the breeding and feeding for the table of this breed is a staple industry of the county of Surrey, and especially around the town after which the breed is named. It is possible that breeders fight shy of the Dorking in consequence of a liability to club foot, and to slight delicacy in the chickens. Of course the change of climate will have no effect in preventing club-foot—that is more a matter of housing, and low perches; but I cannot help thinking that the salubrious climate of the greater portion of this country will have a beneficial effect on their constitution. [The white rose-comb English Dorking is a handsome stately bird, having whiter and, some consider, juicier flesh than the silver-grey. It is a good all-round bird, matures quickly, but does not run so heavy as the grey.—ED.]

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* S. Gray, *Agricultural Gazette*.

"Next in order come the Asiatic breeds, and at the head of these stand the Cochins, and after them the Brahmas. I place them in this order in consequence of the rapid deterioration in size of the Brahmas, caused, I believe, in a great measure, by years and years of breeding for feather. It may be a cause of objection to some readers that the Asiatic breeds come so low down on the list, but still I must hold to my opinion that these birds are disappointing when all the feathers are off. I am quite aware that some specimens of these breeds have reached the enormous weight of 15 lb., but this, it will be admitted, is exceptional, and moreover, such birds are usually past the age when eating them is a pleasure.

"The Langshan has many admirers for table purposes, and I am also looking forward to testing the Orpington. The Houdan also has very high claims to consideration, and lastly I must not forget to include the result of a cross between Game and Dorking, which will hold its own anywhere for size and flavour. [Indian Game and Dorking make a better cross. The White Rock is rapidly coming to the fore as a table bird. Skin and legs are of the recognised tint. It is easy to rear, and is one of the hardiest fowls yet introduced. At six months old White Rocks frequently turn the scale at 7 lb., and at nine months the cockerels sometimes run from 10 lb. to 12 lb. So with the Barred Rock, but the colour of the skin is not so acceptable.—ED.]

"It will be understood that this article is written with a desire on my part to assist poultry-keepers generally in selecting really good table-birds, and I distinctly disclaim any desire to decry the merits of any variety simply by omitting to mention it. Most fowls are good for the table, provided they are healthy, well fed, and young, and my only contention is that my selections give a generally better return for the time and money expended in rearing them; this, I think, is the business way of dealing with the subject, and I wish to treat all poultry matters on a business footing.

"Before closing, it is necessary to refer in general terms to some of the fads which are a good deal written about, as 'market requirements.' Possibly the most prominent of these is the continual insistence on the yellow leg. I shall always maintain that a healthy red comb is of far more importance than a yellow leg. It must be borne in mind that the yellow shank never comes on to the table in a properly-dressed fowl, and as that is the time when one judges of the qualities of a table bird, the colour of the shank would not appear to be of vital importance. Again, the preference for a particular coloured skin may, I think, be similarly disposed of. I should like, also, to anticipate an objection which is likely to be raised in regard to my recommendation that good breeds should be used for the table. All breeders will admit that out of each season's results only a very small proportion will be retained for shows and for the next season's breeding. The majority of chicks are what are known as culls, and this for the most part means that they exhibit some fault in feather or style. These culls, however, mostly possess all the attributes of a breed for table purposes, and it is a well-known fact that all fanciers dispose of their culls every year for human consumption. It is, therefore, apparent, that not only may good fowls be made to pay expenses by disposing of the culls, but, in addition to this, the possession of a number of good birds of any known breed is a continual and ready source of profit, and profit is, or should be, the motto of our farmers."

Ducks.

There are three standard varieties of ducks, Aylesbury, Pekin, and Rouen Of these, the two first named are the most valuable to the farmer. They are hardy, mature quickly, having beautifully white flesh, and are good layers and breeders. For the purpose of securing a large meaty frame, it is a good plan to use a drake not less than nine months old of one variety, with six ducks in their second laying season of the other. Breeding ducks should have free access to water, but must not be fat. Under such circumstances their eggs are more fertile. Ducks should not be used for breeding after their third year, unless of peculiar value either as regards size or laying qualities. Provide a dry snug house during the winter months, and as the breeding season approaches keep them in the house until 10 or 11 o'clock each day, to secure the eggs. Ducks are in the habit of depositing their eggs promiscuously, and unless this plan is followed many eggs will be either lost or broken. The size of the house will, of course, depend on the number of ducks kept, and it is advisable to give them plenty of room. Care should be taken to keep out pests. A floor of well rammed earth, having a slight slope for the moisture to run off, and a litter of chopped straw, which will hold the droppings, and can be raked out occasionally. If a shed is utilised as a duck-house, it may be divided into compartments. This is only necessary when more than one breed is kept, and it is desired to keep them separate.

Hatching.

The most satisfactory plan of hatching is to place the eggs under hen turkeys, each of which will cover about seventeen eggs, the nests prepared as directed in the fowl chapter. In about twenty-eight days the young birds will appear. Incubators are very useful for raising ducks, and provided the breeder understands its use, we strongly recommend it, as a large number can be hatched out at once. For this purpose a good supply of eggs must be available.

Feeding and Preparing for Market.

In order to make the business really profitable, ducks should be fat and ready for market in from eight to ten weeks old, and no bird kept more than three months except for stock purposes. Young ducks as soon as dry should be removed to boxes containing a good litter of straw, each box to contain about twelve ducklings, and the boxes placed in a shed facing the sun. Particular care must be taken to protect them from rats. In England it is customary to run a pair of guinea-pigs where it is desired to keep out rats, and we recommend it. The guinea-pigs must be prevented from leaving the shed. In about twenty-four hours after leaving the shell, ducklings should be fed on oatmeal or pollard scalded with milk for the first fortnight; as they increase in age, give them the following:—Maize-meal, barley-meal, boiled potatoes mixed with a little bran, and softened with hot skim milk; and scalded wheat given as the last feed at night. Animal food and bone-meal mixed through the feed given twice a week. Feed regularly, and not less than four times a day; a little and often will do more good than one large feed. Never give more than they can consume at a meal. Always supply water and grit. Put the food in a trough running along the front of the shed, and clean it out after each meal. The trough can be placed along the outside of the gate with an opening through which the ducks can feed. A duckling at ten to twelve weeks ought to weigh 4 lb. live weight, and increase in weight up to six months. Buyers on the English market are guided by weight.

It is considered necessary by some breeders to have yards in front of the sheds in which the ducklings may sun themselves during the day. This, however, is not absolutely necessary; in fact, in the Vale of Aylesbury, where many thousands are raised annually, the ducklings are kept in the rooms of the cottages, where they are fattened until ready for market. With a view to economy, sheds should be fitted with wire gates, so that the sun may have access to the building during at least a portion of the day, and the young ducks should have the run of the shed. If the boxes are not too deep, they will soon be able to get in and out of them, and by this means will take all the exercise necessary. As far as the fattening is concerned, the less exercise they have the better. But they must be kept in perfect health. With the above provisions hatching may commence at any time, and be continued so long as the breeding ducks provide sufficient eggs.

Marketing.

In all cases it will be found that some of the ducklings by reason of being stronger will eat more or fatten quicker than others. Market the fattest first so as to give the weaker ones a chance. If some make little or no progress, put them in a pen by themselves. For the home market ducklings are sent alive, but for export it is necessary to kill and pluck them. In either case the birds must be clean in feather.

Turkeys.

In order to breed turkeys successfully it is necessary to have a good stretch of country. They do much better when procuring the greater part of their food in the natural way, and this often takes them miles from the homestead. It is, however, necessary they should be kept within reasonable limits. This may be secured by feeding a meal at the homestead each evening; they will then get in the habit of returning, and being thus close at home will roost on convenient trees or fences near by. Whatever hens may be kept it is absolutely necessary to provide a large well-bred gobbler, not less than two years old. The bronzewing is the most valuable. It is hardy, matures quickly, and reaches a very heavy weight; the flesh is of high quality. It is always advisable to breed from fully-matured birds, as the poults have stronger constitutions and are more easily reared. Care must be taken not to inbreed. A fresh gobbler introduced every season is a great advantage. In England cotters seldom keep a gobbler; they simply send their hens occasionally to a local farmer's, it being a curious fact that after a short stay with a gobbler the eggs of a hen will be fertile for a whole clutch. It would be a very simple matter for a few farmers to combine to purchase a really good gobbler and use him for joint stud purposes.

Hatching.

Nests provided in the manner already explained. Each hen will cover about thirteen eggs. A hen turkey can be made to sit sometimes by giving her a glass of port wine and sitting her on a nest. Incubation lasts from twenty-six to twenty-nine days. After the seventh or eighth day remove all infertile eggs, and use them for chicken food.

Feeding the Poults.

Turkey poults require constant care and attention. For the first two or three weeks it is absolutely necessary to keep them from the damp. Never let them out till the dew is off the grass. During this period feed them with hard-boiled eggs, chopped onions, boiled rice, bread crumbs, oatmeal, pollard, or bran. Scald with milk, thoroughly mix it, and when ready it should crumble when dropped on the ground. Give tender green food daily, and bone-meal and animal food mixed through the feed once or twice a week. As the birds increase in age, barley, whole maize, wheat, &c., forms the best evening meal. Provide good dry places for them. As long as covered at night by the mother, they should not be housed. Young turkeys are particularly useful in an orchard; they do not scratch much, and are splendid grub-hunters.

In some districts the young poults are peculiarly liable to a sort of wasting disease. They mope, huddled up, do not care to eat, and become mere skeletons. When this is the case the following mixture, made into pills, has been found an excellent remedy:—Soot, butter, and sulphur (equal parts), a little red pepper, and a few drops of turpentine; a pill three times a day if very bad, and night and morning if only sickening. It is unfortunate that even sick poults must be left with the brood; if separated they mope and die. Another rather common complaint is warts on the head and neck. These are easily removed by rubbing the affected parts with sulphur and lard ointment.

Turkey gobblers under twelve months should weigh not less than 12 lb., and hens not less than 7 lb. live weight. This is low, and may be considerably increased if fed and attended to as directed. As in the case of ducks, weight is of prime importance with turkeys.

Geese.

There are two well-known varieties of geese suitable for the farmer—Embden and Toulouse. For breeding purposes the largest birds obtainable, and not less than two years old, should be used, five geese to each gander. Birds, as a rule, five or six years old, are preferred as breeders, and they are useful until ten to twelve years old. It is well to provide them with a shed for cold nights, and a pond or running stream will be found of advantage. The breeding stock should not be fat. As geese are apt to make a paddock rather dirty, keep them within bounds. Horses do not care to feed after them.

Hatching and Feeding.

The nests are made on the ground. Good-sized hens or turkeys, as well as geese, may be used for hatching, giving them as many eggs as they can conveniently cover. Incubation takes thirty days to complete. For the goslings the same method of feeding as recommended for ducklings is the most suitable. Feed them well from the time they are hatched to keep them growing. Goslings from four to six months old ought to weigh about 10 lb. live weight.

Fattening.

When it is desired to fatten the goslings for market, remove them to suitable yards, with a shed for the night, allowing about 12 feet square for every twenty goslings. Feed with the food recommended for ducklings. Goslings should be allowed a good grass run for the first ten weeks prior to being placed in the fattening yards.

Caponising.

In a matter like caponising so much depends upon the skill and dexterity of the operator that it is difficult to give, except at extreme length, directions that will exactly meet the requirements of the beginner. An illustrated article on the subject has been published in the *Agricultural Gazette*, Vol. iv., Part 9, and those desirous of obtaining a copy will be supplied on application to the Department.

It may be mentioned, however, that cockerels separated as soon as their sex can be ascertained, and kept apart from the hens, will agree and develop into birds that will almost, if not quite, equal capons.

Feathers.

The feathers, too, should not be wasted, for these, when cleaned and sorted, will find a good market if there be a regular supply.

Crates for Live Poultry.

Crates 4 feet long, 2 ft. 3 in. wide, 15 inches high, will hold fifteen pairs of fowls, or twelve pairs of ducks; if used for ducks, a partition should be run across the centre to prevent the ducks rushing from one end to the other and damaging each other. A crate for turkeys, 4 feet long, 2 ft. 3 in. wide, 18 inches high, will hold twelve gobblers, or twenty hen turkeys, or twelve geese. In making these crates the bottoms should be made close, and contain straw or dry grass, to protect the breasts of the birds. Zinc or leather labels should be used, with name and address properly printed on, and attached to each crate.

Diseases.

If the lines laid down are intelligently followed cases of disease on a farm should be very rare. Care must, however, be taken not to introduce it when purchasing new birds. The careful poultry-keeper must have a sharp eye for sick birds. When one is noticed it should be removed immediately to hospital for attention. The hospital should be a clean, dry, airy pen, a little distance away, and must be thoroughly disinfected after the sick bird has been removed.

The two most common diseases amongst fowls are roup and diarrhœa. The symptoms of roup are running at the nose and sneezing. Immediately these symptoms are noticed remove the bird to hospital. A teaspoonful of Epsom salts must be given immediately. When this has acted the head and throat of the bird must be washed with diluted kerosene (two parts water to one of kerosene). Soft food only in a crumbly condition should be fed, and if the attack has been taken promptly the bird will recover within a week. Care, however, must be taken to watch for symptoms amongst the healthy birds. If the disease is found to have attacked several, it is better to remove all the birds into another pen, and have the infected pen closed and thoroughly disinfected.

Diarrhœa is often caused by the drinking water being left in the sun, and by feeding the soft food in a sloppy condition. If promptly attended to a case may generally be cured by feeding a little boiled rice sprinkled with prepared chalk. If there is a tendency amongst the birds in the pen to contract diarrhœa, a few drops of tincture of iron put in the drinking water, in addition to giving rice and chalk, is highly beneficial.

Of course there are many other diseases fowls are subject to, but they are not so liable to occur amongst birds having a free range, and it is impossible to deal with them in the limits of an article. It may, however, be mentioned that full information will at all times be afforded by the Department on application giving symptoms as detailed as possible. It may be taken for granted that clean, dry, airy pens, regular feeding, fresh water, and a fair amount of freedom will prevent disease far better than any treatment will cure it.

In all cases of sickness, except it is a valuable or highly-prized bird that is affected, a tomahawk and cremation is the best and most effectual cure.

EXPORT OF POULTRY TO ENGLAND.*

Prospects.

THAT there is an opening for an export trade in dead poultry from New South Wales to England may be regarded as certain, and in giving a few outlines of advice and information on the subject I shall endeavour to confine myself to the salient points to be observed if a lucrative development of a new industry is to be hoped for. The rearing and marketing of poultry in England is neglected to a surprising extent. Where it is carried on in anything like an extensive scale it is profitable. On small holdings especially the intelligent management of the poultry-yard has proved to be a good paying business. So much so is this recognised that strenuous efforts are being made by the Board of Agriculture, by County Councils, Societies, and local Associations of farmers to direct attention to this branch of small aids to farming. From personal observation I must say that these efforts are not of much avail, and that on both local and other markets English farmers do not make the show they should, and what is done is done in a worthless manner.

New South Wales and other Australasian Colonies, however, have opportunities that Continental nations are not possessed of. In the first place, a drier climate, more suitable for rearing chicks; secondly, the highest prices prevail here in the months March to May, just when the English farmers are unable to place young birds on the market; thirdly, they can be consigned in bulk regularly and directly to the consuming markets. The trial shipments already made have proved successful. We shall have occasion to refer to this below.

Finest Quality Required.

As in the matter of dairy produce, in quality and appearance the poultry must be the *best*, neatly dressed, and clean to the eye. I cannot do better here than quote the words of Mr. C. E. Brooke, Master of the Poulterers' Company: "The better the appearance of the fowl (and this, apart from feeding or fattening, depends upon its being properly killed and packed), the higher, of course, will its market value be, the difference in consequence being far greater than the ordinary amateur is apt to imagine."

Preparation and Packing.

To obtain the highest prices the fowls should be of the finest quality, large, fleshy, and young. It is absolutely necessary that all poultry should be kept without food and water for eighteen hours before killing. They must be carefully plucked, so as not to "bark" the skin, set up in the usual way for market—not trussed—then wrapped in absorbent paper and frozen. The freezing must be so conducted that each bird is frozen separately, packed in crates with latticed sides, and transferred to the freezing-chamber of the steamship. Each crate should hold about three dozen of uniform size, with shelves for each layer. The use of the absorption paper is a necessity. It prevents any moisture clinging to the birds and soddening the flesh when they become partly thawed in course of transit from the ship to the place of sale. Improvement in packing, and consequently in appearance, has been accompanied in all cases by an increase in the prices made far in excess of the cost of any extra labour and time involved. I cannot lay too much stress upon this fact, for on it depends the whole success of the trade. Ducks, fowls, and goslings thus sent should command the high prices here in March and April.

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* Report received through the Agent-General from Mr. C. R. Valentine (Produce Commissioner for the Colony in London).

Since the publication of this work the Board for Exports have provided facilities for the handling and shipment of poultry, and the export trade is now well established. Full particulars are obtainable from the Secretary, Young-street, Sydney.

As to the method of killing,—after the feet have been carefully washed their necks should be wrung near the head. Then they are plucked and drawn and hung by the legs. Plucking must be carefully done, and the chilling take place as soon as possible after it.

As to prices, birds carefully placed on the market with all these precautions can be counted upon to fetch not less than 2s. 6d. a head, whilst extra good may fetch a 1s. and even more in excess of this price. These figures are those of an expert in the trade and based on the results of the Russian frozen poultry trade. They are well within the mark, and from the quality already received, the Australian birds were superior to Russian.

Selecting Breeds.

I now come to the selection of breeds for the English market. At the Birmingham Christmas Fat Cattle and Poultry Show there has always been a class for table poultry, whilst it has been a feature of the London Dairy Show, and for the first time, by the enterprise of Sir Walter Gilbey and the Poulterers' Company, an excellent show was held some time ago in connection with the Islington (London) Fat Cattle Show. A Game-Dorking or Game-Brahma cross produces the best birds, but most judges, as well as buyers for the table, seem to cling to a Game strain, remote or otherwise, at least on one side. The best breeds are the big ones with a Game cross—Dorking, Plymouth Rock, or Brahma. Regularity in size and condition, good white flesh, white legs—which are considered a necessity for table fowl, for yellow and black-legged fowls do not bring such a high price in London. Mr. Tegetmeier says if birds are required for the table, a strong infusion of Dorking blood is most essential. In hardihood and plumpness, the Dorking is improved by the cross with the Indian Game, as it is now called, or with the old-fashioned English game, but not the elongated modern show bird which is now exhibited as a game fowl. The London market is largely supplied with a fowl called "Sussex," itself a kind of Dorking, large, square, and deep in body, with plenty of meat on the breast, and with little offal in proportion to the edible portions. These are crossed frequently with Game or pure Dorking, and first-class fattened chickens make 6s. to 8s. from early spring to the beginning of May at 12 weeks to 14 weeks old. It is this early spring market which the Colony has so many natural advantages to share. After June the prices begin to recede, and every farmer and butter woman has a "spring" chicken of some kind or other ready for market.

At Heathfield, Sussex, where the largest numbers of poultry for the London market are reared and fed, the system adopted is that of "forcing."* It is stated that from Sussex something like 2,000 tons of poultry were railed, to London principally, in one year from the fattening district. The forcing plan is as follows:—They are fed almost entirely on ground oats, mixed to a thick gruel with milk or porridge. When their natural appetite falls off in ten to fourteen days, they are fed by the aid of a cramming machine. The food is the same as before, with a little fat added, and this is pumped into the chickens crops through an india-rubber tube, which is put down their throats. The machine is on wheels, and can be quickly moved along the fronts of the rows of cages, and by its means about 200 chickens per hour are fed by one man. Mr. C. E. Brooke himself, the head of the firm of Brooke Bros., perhaps the largest poultry salesmen in London, breeds and fattens poultry near Horsham, and he uses principally a cross between the Dorking and Indian game, and the Houdan and Indian game. He has achieved splendid results by giving all care to the high quality of the chickens that he breeds for fattening, and the way they are marketed. Frequent and regular feeding from the beginning and gradually reducing the number of meals is necessary. In feeding, the good saleable birds should be picked out and kept separate, so that when killed and packed they are to all intents and purposes "graded" as regards size, as of course they are as regards quality. A good cross is the Dark Brahma hen and the Silver Dorking cock. In feeding it is important to note that the average increase is greatest in the first ten days. Some birds will, under favourable circumstances, put on as much as 2 lb. in three weeks, and kill at from 8 lb. to 9 lb.

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* For a considerable time cramming by means of the apparatus described has been practised at the Hawkesbury Agricultural College with success.

Fattening for Export.

The method of fattening that could best be adopted by the ordinary farmer is very simple, and when carried out on an extensive scale is not costly, as the birds are brought very quickly into marketable condition. Where wheat is so cheap the matter resolves itself into the expenditure of a little extra trouble; but when once a system has been adopted this is hardly worth consideration. The chicks may be allowed to run in the ordinary way until they are from three to four months old. The finest birds should then be selected to the number intended to be shipped, placed in a separate pen and fed three times daily. Wheat should form the staple food, but the birds should have at least one meal a day consisting of ground oats and milk mixed, to which may be advantageously added a little mutton-fat. [This should be the first morning meal, given warm, and should be of the consistency of stiff dough.—Ed.] The fattening course should not occupy more than ten days, and where a large number of birds are handled it is better to have a row of wooden coops raised about 2 feet from the ground, with a trough along the front, into which the food may be placed, so that all the birds may feed at once. In order to ensure cleanliness and health it is customary to have the bottoms of the coops with openings between the battens, so that most of the droppings fall through on to loose mould, which should be taken away periodically and replaced with fresh soil. This makes a very valuable manure, and becomes an additional source of income. A little green food two or three times during fattening will greatly add to the health of the bird.

Eggs.

So far the shipments have not been very successful, the chief reason given being that they were packed too tight. It appears that some trouble is necessary on the part of the farmer in selecting eggs for shipping, whatever style of packing may be adopted. It will be quite useless to attempt to ship eggs laid by hens which are not supplied with plenty of lime, and if this cannot be provided in any other way a piece of unslacked lime or some lime-water should be put into the water they drink. Without lime the shells are always soft and fragile. Another point to be remembered is that the eggs in a case should all be of about one size, and this can be effected to a great extent by keeping one particular breed of fowls. The task of selecting is then greatly assisted. To ensure the arrival of the eggs in marketable condition it is very important to collect systematically, and the shorter the time in which sufficient are collected for a shipment the better will be the results. It is quite useless to attempt to share in the shipping trade if the hens are permitted to lay anywhere. They must be made to lay where the eggs are looked for, and collections should be made daily. Never pack an egg as to which there is any doubt as to when it was laid; it is likely to injure a large number round it, particularly in the case of a breakage. Another important point is that the eggs of hens running without a male bird will keep sweet longer than a fertile egg. With regard to the packing of eggs there is, of course, considerable difference of opinion in view of the great length of the voyage. The system adopted in France, whence most of the eggs come to supply the English market, is to have lightly-constructed cases, about 3 feet long, 2 feet wide, and 6 to 8 inches deep. The eggs are carefully placed in rows on soft straw, a layer of straw between each layer of eggs, sufficient straw being placed on the top so that the fixing on of the lid causes enough pressure to keep the eggs in position. Space is left between the boards to allow the air to penetrate through the package. We are, however, of opinion, that it would pay better to pack them, large end down, in card-board boxes, divided into squares, each square to hold one egg. These boxes, which could hold either one or two dozen, could then be packed in crates, and would carry perfectly. This kind of packing would, doubtless, secure a higher price. There is no necessity to have the cases quite so large, but care must be taken not to have them too deep. Each case should be branded on one end, so that buyers may know what to look for. This is a most important point—as important as it is for the farmer by constant care and attention to keep up the standard of his brand. Recent advices state that the markets will be good from March to May.

Ducks.

For young well-grown ducks there should be a capital opening, and at most remunerative prices, for the Colonial frozen birds would be on the market when similar poultry is almost unpurchasable in London. Pure Aylesburys are to be recommended for early spring ducklings, whilst a cross of Pekin gives even more rapidly maturing birds.

The individual who enters into this business must know that the market will brook no trickery. First quality will pay, but inferior shipments will be a dead loss every time. It is also worthy of note that the difference of seasons is in favour of the Australian shipper. When our hens are laying, and when the chicks are ready for killing, the English market is understocked, and prices therefore are higher. The recent reports of results of a Melbourne shipment of poultry and eggs give the prices of fowls at 4s. 6d. to 5s. per pair, and eggs 10s. per hundred. This shows a very handsome profit, and compared with prices obtained here for farm produce would make poultry the most profitable product of the farm.

We have endeavoured to indicate the lines on which fowls may be made, not only to pay their way, but to materially augment the revenue of the farm. It will probably appear there is a very large amount of work to be done. This, however, is not the case when once the work is reduced to a system. The chief desire is to induce our farming population to take an interest in the work. Once this is accomplished, and the rules indicated are intelligently applied, the idea of work pure and simple will cease, and whatever is done for the birds will be found a pleasure, apart from the question of profit. It is not for a moment supposed all our farmers will become fanciers in the generally accepted sense—this is the work of specialists; but there is no doubt many who have hitherto looked on fowls as a nuisance will find, by keeping a few on proper lines, the interest in it will be aroused. Whenever this occurs success and profit will surely follow. A very important fact in connection with poultry-keeping is, farmers' wives and daughters can do all the work required, with a little assistance in cleaning out the houses and lime-washing; in fact, women seem to get on with the birds, especially the young birds, far better than most men. It is quite common in England and America for the wife to provide, out of her poultry, sufficient ready cash for household requirements. There is no reason why the same cannot be done in this country.

Generally speaking, our Colony is better adapted for poultry-keeping than England and many parts of America, the climate here in most parts being genial and pleasant for the greater part of the year.

Bees.

ALBERT GALE.

BEEKEEPING IN BAR-FRAME HIVES.

The Beginner's Kit.

Bees: bar-frame hives, bar-frames, full size and shallows; bar-frame block; bee brush, a few carpenter's tools, foundation comb, gloves, honey extractor, smoke-bellows, swarm catcher, 1 lb. sections, uncapping knife, veil, solar wax-extractor.

The cheapest way, but, perhaps, not the best, is to get the so-called wild bees that are to be found in the bush. Bush bees are generally of the common black variety, except those that are found near where some one has gone in for the yellow or golden-banded (Italian) varieties. In such localities cross-bred varieties will be met with. Early in the spring vagrant swarms are to be met with either on the wing or settled prior to making a start for a fresh habitation. If settled they will put up with a good deal of handling, and it is almost if not quite impossible to get them on the wing again. If it is difficult to dislodge them from their temporary resting place by the ordinary method of shaking, as many as possible should be brushed off into a box placed on the ground, as directed below. If the swarm is on the wing and they appear inclined to settle in a place awkward to get at for the purpose of hiving, take a small bush or bunch of leaves and slowly brush it up and down or backwards and forwards on their chosen settling spot and they will soon vacate it for one that may be handier and easier to take them from. When about a third of them are settled, take your coat off, roll up your shirt sleeves so that your arms will be bare to the elbow; in your left hand have a candle-box, or one equally light, hold it under the cluster of bees; if they have settled in a bush, or on the bough of a tree, take hold of it near to the bees, give it a quick, sharp, sudden jerk, so that the bees fall into the box you are holding. Be gentle, do not be in a hurry; the bees, if they have not been teased, will not hurt you. Whilst swarming they put on their best behaviour. They are never more docile than when they leave the parent stock to establish themselves as a new colony. If you are of a timid nature, and most novices in beekeeping are, put on a veil, tie your coat sleeves tightly around your wrists, so that the bees cannot get underneath it. It is when they are imprisoned, and pressure brought to bear by the coat, that they get angry, and they then draw swords in self-defence. Should you be stung, keep cool, grin and bear it. For if you strike at the bees, and run "with what measure ye mete, it shall be measured unto you again"—yea, and that ten-fold. As soon as the bees, by means of the jerk, have fallen into the box, lower it to the ground, turn it gently over, mouth downwards, so that the bees roll out on to the ground, place the mouth of the box over them, one side of it resting on a small stone or bit of wood, so that they can have ingress and egress. If you have secured the queen, the bees on the wing will quickly gather around the box; if she be not there, they will speedily return to the spot from whence they were shaken. In that case wait till they have again clustered, and again go through the process of boxing. When you have safely boxed them, take them home, where you should always have a hive properly supplied with frames fitted with foundation comb ready for their reception. Remove the cover of your hive, take the box containing the bees in both hands, the open end *upwards*, gently shake by swinging the box around, as if washing out a bucket; do not be rash, and throw them on to the top of the bar-frames. Cover them over with the quilt till evening, by that time they will have descended; you may then replace the cover of the hive. If your hive is within 2 or 3 inches of the ground, and it should not be more, you may turn out the bees on the ground in front of the hive, close to the entrance: they will soon find their way in.

If the bees are established in a tree or log, they will have to be cut out by the method known to every bushman. You want the bees, not the honey. Let the bees be primary and the honey secondary. If you can reach the bee-entrance to their nest, take the smoke-bellows and blow in a fairly good supply of smoke. Sometimes the comb is some distance from the entrance; in such cases more smoke is required than if it be nearer. The smoke and the jaring caused by the axe in cutting into the tree frequently causes the majority of the bees to leave the comb and retire into some other portion of the hollow, where they will be found clustered, as they are frequently seen hanging on a branch. Oftimes to dislodge them requires patience. If they are easily reached, lay open the cavity in which they are clustered by cutting away the timber; place the open end of an empty box over the bees; a few puffs of smoke from the bellows will often cause them to shift their quarters and enter the box that has been placed for their reception. If it be found that they cannot be dislodged in the way described, they can be taken out with the hand or a teacup; care must be taken not to crush any of the bees, as it may cause them to lose their temper.

In taking a swarm of bees from a tree, always, if possible, see that you have the queen. She is easily recognised by her size. When you have once seen a queen bee you will soon learn to pick her out. Should you be so fortunate as to see her, take her up by the wing or the shoulders (she will not sting you) and put her into the box with a few workers. The other bees will soon find out where she is, and follow on like a flock of sheep.

Perhaps you may have bees that are already hived in a gin case or other makeshift box that you wish to transfer to a bar-frame hive. This is the way it is done :—Choose a bright warm day, blow a puff or two of smoke into the hive you wish to transfer, and take it to a shady place, say under a tree, some little distance from the site it occupied. Turn it upside down. On the open side of the box, and immediately over the comb where the most bees are congregated, place the open end of a smaller box, *i e.*, opening to opening, with about a third of one side removed; this is for the purpose of watching the bees ascend. It is not necessary to close the open end of the box containing the bees so that the bees cannot escape; there will be no danger of the bees rising on the wing. When the boxes are in position, drum the sides of the box containing the bees; in a very few minutes they will be seen marching into the upper box. Place them in their new home in the manner before stated. Be sure to place the bar-frame hive on the site occupied by the one you transferred.

A bar-frame hive must be placed perfectly level so that the frames will hang truly plumb. If a large number of bees are to be kept, place the hives about 6 feet apart in the row, or 12 feet between the rows. These distances are not imperative, but bees so located are more easily manipulated.

Bar-frame hives, bar-frames, and bar-frame block have been described, and the measurements of the various patterns have been given in the late numbers of the *Agricultural Gazette*. [*See* illustrations, p. .]

If you desire to make your own (these things can be bought very cheaply from dealers in bee materials) you will find ample instructions there given to construct very useful hives, &c.

The *bee-brush* is used for the purpose of removing the bees from the comb when you wish to have the comb entirely free from occupants. A bunch of leaves, especially fern fronds, makes a very good one. With it brush the bees lightly from the comb back into the hive. For the purposes of observation enough of them can be removed by holding the frame of comb over the hive and giving it a sudden jerk.

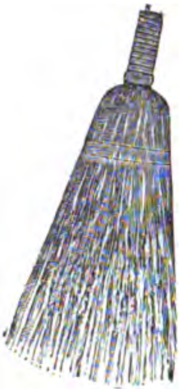
Fig. 1.—Bee-brush.

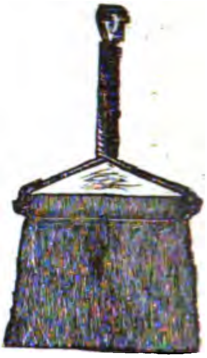
Fig. 2.—Bee-brush.

Carpenters' bench tools, not a complete set, will be necessary only in the case when you prefer to make all the woodwork "on the premises."

Foundation Comb.—This can be bought from dealers at from 1s. 9d. to 2s. per ℔. There is what is termed brush foundation. With a little practice this can be home made. To do so it will be necessary to obtain from a dealer a plaster cast. Briefly, this is the way to produce it from the cast: Soak the cast in soap-suds for a few minutes before using. Have a glue pot or other vessel containing molten wax, which should be kept at almost boiling point. A fair sized paint brush with the bristles not too long should be kept in the wax during the time it is melting. With this brush, paint the molten wax over the plaster slab by one or two rapid strokes. The fewer the strokes made with the brush the neater and more even will be the foundation. It soon cools, and is then easily peeled from the plaster cast. This brush foundation will answer very well as a substitute for mill-made.

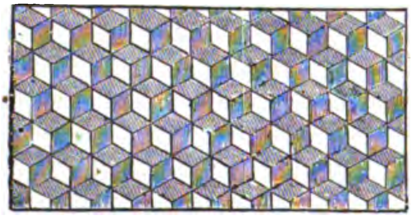
Fig. 3.—Foundation Comb.

Gloves.—There are gloves made expressly for the handling of bees. They are seldom, if ever, used by the practical bee-keeper. Nevertheless, timid beginners may be excused for so doing, more especially if they are ladies. Bees can sting through any ordinary wearing glove. Proper bee gloves are made of india-rubber.

Honey Extractor.—There are several different kinds of honey extractors in use, both two and four frame. Some are reversible, *i.e.*, the comb can be reversed without removing it from the extractor. It will not be necessary to purchase one when you begin bee-keeping. They are rather expensive. When you have fairly started in the industry it will pay to buy one. Remember, every time comb is destroyed it is a loss of profit.

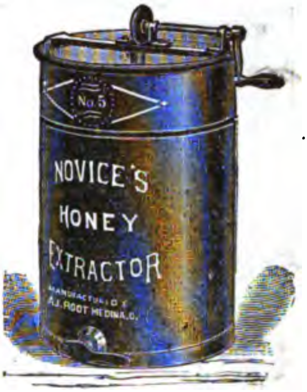

Fig. 4.—Honey Extractor.

Wax is a secretion and is produced from honey. It is estimated that 1 lb. of wax costs the bees from 10 to 15 lb. of honey to produce. I have seen some very serviceable extractors made by amateurs.

The Quilt.—This is a piece of American leather the full size of the top of the hive, and is placed over the frames next to the lid. During summer the enamelled side should be placed immediately over the frames, but in winter the cloth side should occupy that position. In placing it between the cover of the hive and the bees it has the advantage of confining the bees to the hive after the cover has been removed until they have been subdued.

The Smoke Bellows.—There are hot and cold-blast bellows. In the first named the air is blown through the fire and thus becomes heated. Beginners unacquainted with this fact frequently injure some of their bees by holding the bellows too near to them. A bellows on the hot-blast principle produces a greater volume of smoke, and therefore more readily subdues the irritability of the bees, but too frequently sparks of fire are carried with the smoke into the bees. The cold blast is the safer, especially in the hands of a novice. No bee-keeper can do without a smoker. The smokers in the market are the "Root" and the "Bingham," both of which are on the hot-blast method. As a cold blast, the "Clark" has had a good innings, but is rapidly being superseded by the "Pender." This is also a cold blast, and can be used with the greatest safety by the most inexperienced. The materials used for charging the smoker are various—semi-decayed wood chips, and saw-dust from the wood heap, discarded cotton-waste, old bags, cow droppings, &c.; anything that will smoulder is suitable. The last named must be perfectly dry, and has the advantage that it is almost impossible to blow it into flame.

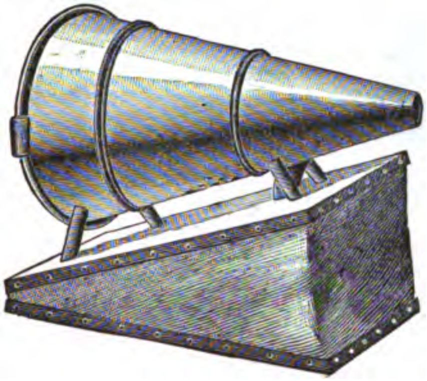

Fig. 5.—The Smoke Bellows.

Swarm Catcher.—This is a very useful appliance. A bag made of mosquito net and sewn to a hoop of about 15 inches in diameter makes a very good one. It should be fixed to the end of a long, light pole, and at right angles to it. With such an instrument when a swarm settles on a tree out of ordinary reach they can be secured by such an appliance and brought to the ground. An open box, the remaining sides having three or four 1-inch auger holes pierced in them, and fixed to a stand of about 10 feet or 15 feet high, in the form of a tripod is a first-rate appliance for bees to settle in, especially if a dead queen be fixed within. When the swarm is on the wing this box, stood up in the midst of them, is almost sure to attract them to settle therein, and, if so, it will save a deal of trouble in following them.

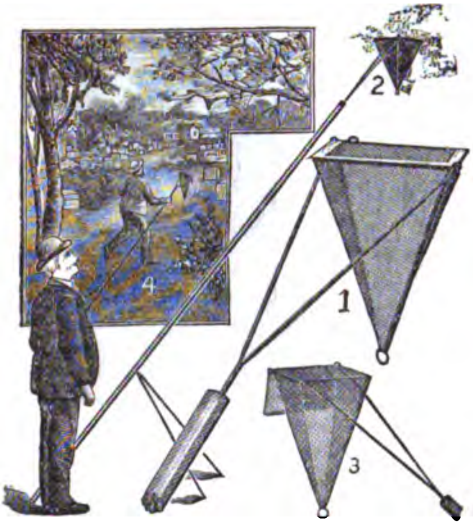

Fig. 6.—The Swarm Catcher.

One Pound Sections.—These can be bought very cheaply. They are, when nicely and evenly filled, very saleable. There is not so much profit in producing sections as there is in extracted honey, but they are very nice for table purposes.

The Uncapping Knife.—These are required only when you have a honey extractor. As the name implies, they are used for the purpose of removing the caps from the honey cells before placing the frame in the extractor. For uncapping two knives should be employed. These should be placed in a tin billy of hot water, or some other such vessel, and used alternately. The water can be kept hot by means of a small lamp placed under the tin billy. When uncapping, cut downwards. This will cause the cappings to fall more readily.

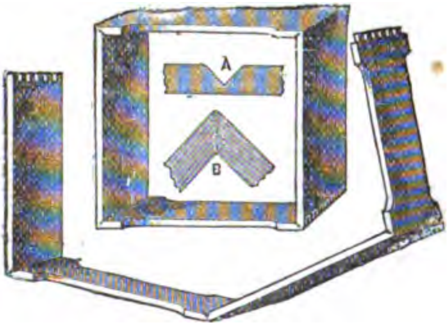

Fig. 7.—One Pound Sections.

Bee Veils.—These are a great protection to the face whilst working among the bees. A bag made with mosquito net and open at both ends is the usual thing. A broad-brimmed hat, with such a bag sewn to its edge, is the most convenient. Let it be long enough to come well over the shoulders. It will be found difficult to see through the ordinary white netting; therefore, for the face, a small square of black Brussells net should be inserted for the purpose of obtaining a clearer vision of the work. Some veils have gauze wire fronts, others glass. As you obtain confidence, the veil will be discarded.

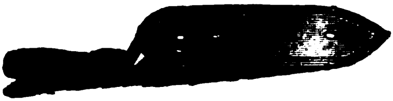

Fig. 7.—The Uncapping Knife.

The Solar Wax Extractor.—This is a very handy thing—a sort of save-all. A shallow box, with glass lid, is the thing required. A convexed, semicircular false bottom, made of bright tin, is fixed within. The deepest part should not be more than 6 inches from the glass. One end of the false bottom should be made of gauze wire to act as a strainer, the other of tin. Room should be left at one end of the box to receive a vessel to catch the wax as it drips through the gauze wire. The cover should be easily removed. Place the box at an angle of about 20 degrees facing the sun. All pieces of waste comb should be thrown into it. Always keep the cover on, night and day. It will soon pay for itself. Waste bits of comb lying about encourages the bee moth.

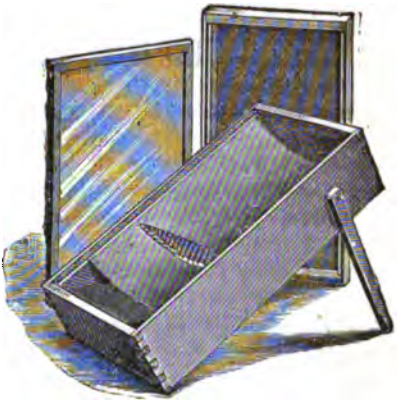

Fig. 9.—Solar Wax Extractor.

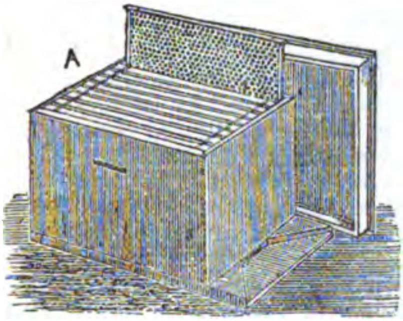

Fig. 10.

The best time to manipulate bees is when the day is brightest. The best site for your bees will be the most convenient, so long as they are sheltered from the cold winds of winter. Put the hive about 3 or 4 inches from the ground, resting on bricks, with a platform having a gentle slope inclining from the alighting board to the ground, and be sure to make the roof water-proof. Bee-keeping will pay if it be properly looked after, if it be only one or two hives to supply honey for your own table.

The following (Figs. 10 and 11) are diagrams of a simple bar-frame hive, and show the ordinary frames and pound sections.

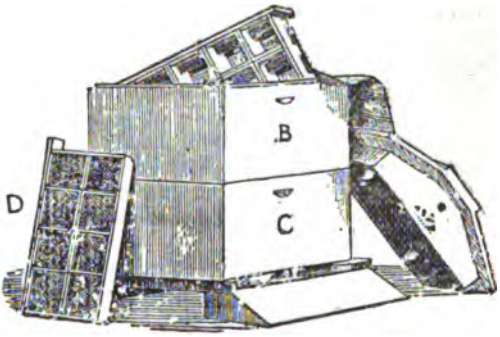

Fig. 11.

Full particulars as to the construction of these hives are given in articles reprinted from the *Agricultural Gazette* in pamphlet form, which can be had free on application to the Department.

The principal diseases of bees are foul brood and moth. If the hives are examined occasionally diseased comb or moth larvæ can be removed and destroyed.

We are indebted to Messrs. Hebblewhite & Co. for the loan of blocks 1 to 9.

Calendar for Vegetables and Flowers.

W. S. CAMPBELL.

JANUARY.

Vegetables.

THE growing of vegetables becomes rather difficult during the hot dry months of summer in those parts of the Colony where the supplies of water are insufficient to permit of the watering of plants. In such cases the best method to adopt is to cultivate the surface of the soil between the vegetables as frequently as possible, no matter how dry and dusty the soil may be. For this purpose the Planet Jr. hand-hoe will be found most effective, but if this cannot be obtained, an ordinary hoe or a good well set Dutch-hoe will answer the purpose, but the work cannot be carried on perhaps quite so speedily.

A heavy mulch of farm-yard manure will prevent evaporation and serve as useful plant-food as well, and when dug into the soil after it has served its purpose as a mulch will prove valuable, not only as plant-food, but, during its process of rotting, will perform important work in making the soil better adapted for plant growth.

Bean, French or Kidney.—This vegetable may be sown to as great an extent as may be required. The best plan to adopt is to sow a row or two once a week, or perhaps it would be better to sow a row, wait until the plants have come up, then sow another row, and so on. The ground should be well dug in the first instance, and if it is not naturally sufficiently rich, it should be heavily manured with well-rotted farm-yard manure. It may be as well to state that if the so-called chemical or artificial manures are used, sulphate of ammonia, nitrate of soda, or manures known as nitrogenous or ammoniacal manures, are of little if any use for French beans. Lime, gypsum, potash, or sulphate of lime are the best substances to apply, but it is hardly possible to do better than use plenty of well-rotted stable or farm-yard manure for any vegetables whatever. This is always safe, and, as a rule, most effective.

Beet, Silver.—Sow a little seed, and transplant from the seed-bed if there are any plants large enough to move. The leaves only of this plant are used, and they make a very palatable dish, if they are properly boiled.

Cauliflower.—This month is a good time to plant out cauliflowers from the seed-bed. In the first place, prepare some ground by trenching if possible, or deep digging, and thoroughly well manuring, mixing in the manure well. If the soil is dug or trenched deep the roots of the cauliflowers can descend to a considerable depth in search of food, and are not likely then to suffer from dry weather. Select good strong sturdy plants and set them about 3 feet apart each way. Do not break or injure the roots more than can be avoided when raising the plants from the seed-bed. Sow a little seed for future supplies in a seed-bed or box where it can be shaded or watered easily.

Cabbage.—Sow a little seed and shade and water. Put out a few young plants in well-manured and well-prepared ground.

Celery.—A little seed may be sown, and a few plants put out in well-manured or rich ground. This vegetable will need to be well watered and also treated to occasional supplies of liquid manure.

Carrot.—Sow a little seed in drills, taking care to separate the seeds well before they are sown. Thin out any young plants that may be coming on, and be careful to keep them free from weeds.

Kohl rabi, or turnip-rooted cabbage.—A few seeds may be sown in a seed-bed. Seedlings to be planted out later on when they are large enough to move.

Lettuce.—Instead of planting out from the seed-bed it will be better, at this season of the year, to sow in rows in a richly prepared bed in the garden and thin out the plants to about 9 inches apart when they come up. If lettuces are transplanted just now they are very apt to run to seed.

Maize, Sweet.—It is late to sow seed, unless it is done very early in the month, and then only in the warmest districts.

Peas.—In the coolest parts of the Colony a few rows may be sown.

Potatoes.—Prepare a bed for planting by deep digging, well draining, and heavily manuring. When ready, plant some variety of the kidney potato. Use medium-sized whole tubers, for they will probably succeed better than large ones cut into two or more pieces. The rows should be from 2 ft. 6 in. to 3 feet apart.

Radish.—A supply of this vegetable, if young and tender, is always useful. It can be sown during every month of the year. A very little seed should be sown at a time. If well grown the tender leaves may be eaten as well as the root. Make the ground fine and manure well with rotten dung. Sow in little rows, thin out, and keep free from weeds.

Red-beet.—Sow a row or two of this useful salad vegetable on some ground that had been previously heavily manured for cabbage, potato, or some other crop. The seed will probably take a long time to come up, especially if the ground is dry. If it be thoroughly soaked in water before it is sown and the drills in which it is sown are also well watered it will come up much sooner than otherwise.

Savoy.—Sow a little seed. This is one of the best of the cabbage class, which will succeed to the greatest perfection in rather cool districts, although it may be grown in almost any part of the Colony.

Tomatoes.—In most gardens there should be good supplies of ripe fruit. Some means should be adopted to keep the branches or vines from lying on the ground and thus rotting the fruit. They are awkward plants to tie up if allowed to attain full growth before the tying up is attempted. The work should be done as they grow. Bundles of sticks, prunings of fruit-trees, or dead branches of trees can be spread under the plants, and this will answer in a rough way to serve the purpose. If required, young plants may be put out to keep up a succession of fruit.

The month of January is generally considered to be an "off" month for vegetables, and there is often a scarcity if the weather proves dry; but, with a little care and trouble, if a good supply of water is available, quite sufficient may be raised for all requirements.

If onions are ready for lifting care should be taken to do the work without bruising them, and after they are raised do not, on any account, leave them in the sun to dry, or else they may not keep for any time.

The Flower Garden.

It would be well to mark with strong, short stakes the places where bulbs are growing, for they are now casting their leaves, and probably their places will be forgotten and the bulbs injured. If desired, the bulbs may be taken up and stored away in a dry, airy shed or outbuilding until required later on for planting. But there is no necessity, really, to raise the bulbs unless to divide them. Many roses will cast their leaves about this time of year, especially if the weather is dry. They may be pruned back, just as if it were winter or early spring, and the plants will produce good flowers in the autumn. Many of the tea-scented varieties of roses will probably bloom well during the month. This is a good time for budding roses, if it be desired to increase the stock of plants. The bark will probably "rise" freely, especially after rain. They are the most useful class of plants for small gardens. The best flowering plants for the summer and autumn months are the Bouvardias, of which there are many beautiful varieties. Chrysanthemums will need good supplies of water, and also weak liquid manure. The plants had better be well mulched with farmyard manure. Dahlia plants should be tied up to stakes as they grow, and they will need plentiful supplies of water and liquid manure. Small plants like cowslips, daisies, or polyanthus, if allowed to remain in the garden fully exposed to the hot sun, will very likely die. They had better be watered, and removed to a cool, shady place for the remainder of the summer, and can be replanted in their old situations in the winter or early spring.

FEBRUARY.

Vegetables.

FEBRUARY is generally about the hottest and driest month of the year throughout the Colony, except in some localities on the coast, where there is frequently an abundance of rain. It requires much perseverance, doubtless, in the dry places to raise vegetables of any kind, especially where water is scarce. Constant cultivation with the hoe, no matter how dry the soil seems to be, will be most beneficial to the plants. One great secret in raising vegetables in dry weather is having the ground dug deep before the vegetables are planted or sown. When it has been dug or trenched (say) 2 or 3 feet deep, the roots of the vegetables are enabled to penetrate to a great distance into the soil, and obtain moisture below the surface.

Liquid manure, which can be made from the dung of animals soaked in water, is of great value for vegetables, but should not be used over strong, especially if it has fermented, in this case it should be considerably diluted with water. Experience will soon show the best strength to use if the effects of various applications be noted carefully.

Save all waste water from the house, and it will be found of much value when the water supply is short. If liquid manure be used it should on no account be poured over the leaves of vegetables, but be applied to their roots only. This can most easily be done by drawing away the soil, or rather by making a little shallow furrow or trench, into which the manure can be poured, and when it has soaked into the ground the soil should be covered over again. There is but little trouble about this work, which can be effected very quickly with a hoe.

In order to raise a sufficient supply of vegetables for transplanting later on, a good many different kinds of seeds must be sown, and some trouble should be taken to make suitable seed-beds or to prepare boxes or seed-pans in which to sow the seeds. Some stuff for shading will be necessary. On the coast, tea-tree brush is about as useful a thing as could be obtained.

French Beans.—These may be sown during the month to as great an extent as may be required. The best kind for general purposes is that known as Canadian Wonder. The Butter beans are good, and some should be sown.

Beet, Red.—Sow some seed in rows. Probably one row will be sufficient at a time. Select rich ground, such as had been heavily manured for some previous crop. Before sowing the seed make a shallow drill—say about an inch or so deep. If the soil has been made quite fine a drill can be made with the forefinger. Drop the seed along the bottom of the drill, and if the soil is dry, water well before covering up, so as to give the seed a thorough soaking, and then cover over with fine soil, and press it down with the back of the spade. Always use a line to mark out the rows. A clothes line will serve the purpose well, and will last for a long time if taken care of. Plants that are growing should be thinned to about 9 inches or even to 12 inches apart in the rows. If the young beets that are thinned out are lifted with a little care they may be planted out if required.

Beet, Silver, or Spinach, is an excellent vegetable to grow. Sow a little seed in rows, and afterwards thin out the seedlings when they have attained a height of about 2 or 3 inches. It may, perhaps, be more convenient to sow in a seed-bed and afterwards transplant in much the same manner as is adopted for cabbages, &c. The soil for this plant should be heavily manured with well-rotted, rich manure, for the leaves, and not the root, is the part used as a vegetable. The rows in the permanent bed should be about 2 feet apart, and the plants should stand about 2 feet distant from one another.

Borecole or Kale is best suited for the cool parts of the Colony. It belongs to the Brassica or cabbage family. The seed should be sown in seed-beds or boxes, and the seedlings afterwards transplanted. The soil should be made rich with well-rotted stable manure. Plant in rows 2 feet apart each way.

Broccoli resembles the cauliflower, and might easily be mistaken for it; in point of fact, it is a variety which takes longer to arrive at maturity, and there are other differences which are very apparent to one used to growing vegetables. Seed to a small extent may be sown in a box or seed-bed.

Brussels Sprouts.—This is another and excellent variety of the cabbage, but which differs in a most marked degree from that vegetable. The stem grows to a considerable height, and bears numbers of miniature cabbages. It is very suitable for cool districts and should be grown wherever it will thrive, for it is one of the best of vegetables, and can be grown as easily as an ordinary cabbage. Seed should be sown in a box or seed bed, and every care should be taken in watering and shading sufficiently. When the plants are large enough they should be moved to well dug up but not too heavily manured ground that has been prepared for them. The growth should not be too rank, and the plants must not be forced, or else the young sprouts will not form well. If the ground is naturally rich it may, perhaps, be as well not to apply manure. However, if they do not thrive, manure can easily be applied in a liquid form. Plant in rows about 2 feet 6 inches apart. The plants to stand about 2 feet from each other in the rows.

Cabbage.—Sow seed, in as great a quantity as may be needed, in a seed-bed. Sow thinly in little rows, about 2 inches apart. A few plants may be set out in well-manured ground, from time to time, in order to keep up a succession.

Carrot.—Prepare some ground by digging deep and fine, and by well draining, but avoid applying manure unless absolutely necessary, and then take care that it is old and thoroughly rotten. The best way to manage is to use a bed, or part of a bed, which had been heavily manured for some other vegetable. If fresh manure is used the roots will, in all probability, become forked, and of bad shape. Sow the seed in drills, which should be made not deeper than half an inch. Cover over with fine soil, and firm down with the back of a spade. The seed is covered with little hooks, and care should be taken that it be well separated before sowing. The drills should be from 1 foot to 18 inches apart. The seed will take a good while to come up, and as the plants are exceedingly small at first the weeds should be looked to as often as possible.

Cauliflower.—Seed of this favourite vegetable may be sown largely during the month in a seed-bed, box, or pot, in the same way that cabbage and all others of the same family are sown. The seedlings, when large enough to move, will be improved by being planted out or "pricked out" in a small bed about 4 inches apart, where they can develop into good, strong, young plants for transplanting. The distance apart the plants should stand will depend on the richness of the soil. The better the soil the wider apart the cauliflowers should be planted. The distance may vary from about 2 feet or 2 feet 6 inches to 3 feet. At the same time, it should be kept in mind that although the soil may be poor, and but little manure has been dug into it, the plants can be fed by liquid manure, and made to grow to a very large size. In a few words, the distance at which plants should stand from one another will depend, in a great measure, on the quantity and quality of plant-food available.

Celery.—Sow a pinch of seed in a box or pot. When the plants come up, and are large enough to shift, prick them out in a small bed, where they can grow strong and hardy.

Endive is a good substitute for lettuce. A little seed may be sown during the month.

Turnip, White.—Seed may be sown in drills, in well-manured ground. When the plants come up, thin out well.

Turnip, Swede.—Sow as largely as necessary, as above.

Potato.—An effort should be made to raise a good supply of this useful vegetable. The soil should be well drained, well worked, and heavily manured with the droppings of farm animals. For seed, medium-sized whole potatoes are to be preferred to large ones cut into sets. The rows had better be wide apart, say 3 feet, and the sets put in about 1 foot apart in the rows. Plant about 5 or 6 inches deep. If it is necessary to use cut sets take care that the cut sides are dry before planting.

Peas.—If the weather is moist a few rows may be sown in the cool districts. The dwarf varieties are to be preferred for this season of the year.

Radish.—Sow a few rows occasionally during the month. Use well-rotted manure, and water occasionally if the weather is very dry.

Flowers.

Although February is a very hot month, and flowers will suffer considerably unless they obtain all the moisture they need, the cooler weather, known as the autumn, will set in towards the end of March. Now, the autumn is the very best time of year in which a great deal of important gardening work can be done. It is the best time in which to plant out evergreens—that is, those plants which do not shed their leaves during the winter. To this class of plants belong camellias, most of the azaleas, rhododendrons, palms, most of the pines, and various other garden-plants; therefore it would be advisable to get ready any ground, without delay, that it is intended shall be made into a garden. It would be as well, also, to get ready some place where seeds of hardy annuals and other plants can be sown and protected; for if the plants are raised in the autumn, and planted out when they are large enough, they will produce flowers very early in the spring. It is much better to plant out everything possible in the autumn than in the spring. If preferred, the seeds of annuals can be sown in the garden where the plants are to remain, but the chances are that the best results will be obtained by sowing in a seed-bed, box, old kerosene-tin, or something of that sort, and afterwards transplanting the seedlings.

Chrysanthemums will need looking after, and watering if the weather is dry, and grubs and caterpillars should be looked for every day and removed. If black aphis appear on the ends of the tender shoots, and between and amongst the leaves, dust them well with tobacco powder, insect powder, or spray with resin and soda mixture, or even, where these things cannot be easily obtained, with starch and water, or with soot and water. Soot-water is a good manure for chrysanthemums, but not easy to make unless you know how. Collect a good lot of soot and put it in a sugar-bag, or something of that kind, and then let this soak in a tub of water. When the water becomes the colour of strong tea it is ready for use.

Dahlias will soon begin to flower well. They, too, must be well watered if the weather is very hot and dry. The plants should be secured to supports of some kind, or they are almost sure to blow down and perhaps break off. Bulbs, such as daffodils, may be taken up and replanted if it is necessary to thin them out. This is a very good time to plant out bulbs, especially narcissus of kinds, sparaxis, tritonias, ixias, babianas, and other Cape bulbs. Gladiolus bulbs also may be planted, or dug up and replanted where necessary.

MARCH.

Vegetables.

THE weather is likely to become gradually cooler, and a sort of second spring will take place, which makes the autumn one of the most pleasant seasons of the year. Clear up all rubbish, weeds, useless vegetables, and so on, and heap them together to rot, and they will become most useful manure when they have decayed away. Whenever this rubbish stinks or becomes offensive, throw a few spadesful of dry soil completely over it from time to time, and it will prevent all disagreeable odours from arising.

Every opportunity for preparing new ground should now be taken, and any ground that has been under crop for a long time could be much improved by trenching 2 feet deep at least, and by draining. If it had been trenched, it will do it all the good in the world to retrench. It may be mentioned that land that is trenched, and not well drained, is very liable to "run together" again—that is, to become hard below the surface. There is perhaps no more important operation, either in agriculture or horticulture, than draining; but unfortunately for those who neglect it, is but seldom properly attended to. When trenching or deep digging is being done, it would be wise to mix some good manure with the soil—not merely with the surface soil, but the whole depth.

Asparagus.—It would be advisable to get a bed ready for some plants as soon as this can be done. The ground should be trenched 18 inches or

2 feet deep, some manure being well mixed up with the surface soil as it is being dug. It is not necessary to make a very large bed, for a few plants even will give an occasional dish, if the plants are looked after; and if the soil happens naturally to suit them the supply will be considerable. When the ground has been dug up the surface should be left as rough as possible until the time comes for planting in the very early spring. Asparagus likes a rich sandy deep soil, but it will grow fairly well in almost any kind of soil that has been well prepared. It is a native of the sea-coast of Europe, and has been in cultivation from remote times and long before the Christian era. It is found growing wild in the sandy interior of Russia, far away from the sea-coast, but probably the soil there is saline. It should grow well in the inland parts of this Colony where the saltbush grows, and it will probably succeed splendidly where it could be irrigated by the water from artesian bores. At the present time nothing need be done beyond preparing the ground.

Bean, French or Kidney.—In the warm districts of the Colony a few rows should be sown, if the soil is not very dry. It will probably be too late to sow in the cold districts, for the plant cannot stand frost. Plants that have ceased to bear should be pulled up to make room for some other kind of vegetable. Old withered plants of beans or peas when allowed to remain give the vegetable garden a most miserable neglected appearance, besides taking up space that might be producing something useful. Every grower of vegetables should strive to keep his garden tidy and make it worth looking at. If this be done the place will become more and more interesting and profitable.

Bean, Broad.—The soil best suited to this vegetable is a heavy clay loam, although it will grow and bear well in almost any kind of soil. It would not be advisable to sow to any great extent during the present month. Dig the ground well, and if it is poor apply plenty of horse or cow dung, and if this has been well rotted, all the better. If artificial manure is used, apply little or no sulphate of ammonia or nitrate of soda. Use bone-dust or superphosphate of lime and potash. Sow in rows from 2 feet to 3 feet apart, according to the variety, for the dwarf-growing kinds may be sown closer together than the tall. The seed should be sown about 4 or 5 inches apart in the rows.

Beet, Red.—Sow a row or two of this useful vegetable. Thin out well any plants that are coming up from previous sowings.

Beet, Silver.—Sow a little seed in ground that has been well manured—that is, if the soil is not naturally sufficiently rich without it, which is seldom the case.

Borecole or Kale.—It is doubtful whether this vegetable is worth troubling about when there are so many other kinds of the cabbage family can so easily be grown in the Colony. It will succeed best in the coolest districts. Seed may be sown in beds or boxes like cabbage, and the seedlings afterwards transplanted. It prefers a rather stiff soil, but may be grown successfully in almost any garden.

Broccoli.—Seed may be sown in the same way as cabbage seed, and the seedlings afterwards transplanted, bearing in mind the rule that the richer the soil the wider apart the plants. Plants available from previous sowing may be planted out.

Cabbage, *Brussels Sprouts*, *Cauliflower*, and *Savoy* may be planted out if well-grown seedlings are available. Seed also may be sown, and care should be taken not to sow it too thick in the drills.

Celery.—Sow a pinch or so of seed in order to have plants available when required. It should be remembered that celery requires a great deal of moisture during its growth, for its native localities are wet and marshy places. Plant out a few well-grown seedlings in well-manured ground. Make shallow trenches so that water and liquid manure when applied will not run to waste. It may be mentioned that although the plant requires plenty of water during its growth, it may be possible to over-water, whereby the result is a loss of flavour. The proper quantity to apply can only be learned by experience, and anyone who will take an interest in the gardening work will soon learn. The best manure to use for celery is the droppings of farm animals, mixed well with the soil when the ground is being prepared. If anyone wishes to try the common old method of growing and blanching this plant he should dig out trenches 12 inches deep or more and about 16 inches wide, the soil taken out of the trench to be spread along the top of the bank. At the bottom of the trench dig in a good supply of manure and plant strong stocky young seedlings 9 inches apart in the middle of the trench. The seedlings should be moved from the seed-bed with care, and the roots injured as little as can be avoided. When the plants have attained a good growth they can be earthed up so as to make the stalks white, or "blanched," the ordinary term used. The soil must not be allowed to drop into the centre of the leaves, or they will probably decay or become injured and unfit for use. Some gardeners use paper round the stalks; but this is unnecessary if the stalks are held together, and care is taken when earthing-up is done.

Cress and Mustard.—Sow a little seed every now and then in a small, well-manured piece of ground. The plants will need water frequently when they come up, and also subsequently.

Endive.—Seed may be sown in a seed-bed or in boxes, and when the seedlings have grown large enough to handle they may be transplanted. This plant is best suited to a warm climate. Plant out about 1 foot or 15 inches apart. When the plants are pretty well full grown the leaves should be tied together so that the inner ones may become white and tender.

Herbs.—Seeds of all kinds may be sown. These useful plants should not be forgotten. Sow in pots, boxes, or seed-beds, and afterwards transplant. Parsley should be transplanted whilst it is very young, for it soon sends out a long tap-root, which had better not be broken.

Lettuce.—Sow seed in the seed-bed for future planting out. If any strong young lettuces are to be had plant them out in rich, well-dug ground. It is very often the custom to sow lettuce seed, at this season of the year, in rows where the plants are to grow, and not transplant, because transplanted lettuces are very likely to run quickly to seed.

Leek.—This time of year is about the best season to sow seed largely of leeks. Prepare a seed-bed and sow in rows. When the plants are about 6 or 8 inches in height they may be transplanted to a bed made exceedingly rich with good farm-yard manure. Make shallow trenches and plant in rows about 18 inches apart, the leeks to stand about 9 inches from each other. Water and liquid manure will be needed often if it is desired to grow the best of plants.

Peas.—In cool, moist climates sow a few rows of this excellent vegetable. Prepare the ground well, and, if it is poor, apply a good deal of farm-yard manure.

Radish.—Sow a little seed occasionally to keep up a supply.

Sea Kale.—Sow a little seed in a seed-bed and afterwards transplant the seedlings, just as cabbages are planted, to well-manured, deeply-prepared ground; when the plants attain a good size they need to be covered and blanched, and for this purpose special kinds of pots are made, but dead leaves, manures with plenty of straw, boxes, or something to keep the light away from the plants, will answer.

Spinach.—Sow seed in drills in rich, rather moist, but well-drained soil. Let the drills be about 18 inches apart, and when the seedlings appear, thin them out well. This is a very good vegetable and well worth growing.

Shallots and Garlic.—Plant out in drills about 1 foot apart as much of this useful vegetable as is likely to be required. The bulbs or cloves can be purchased from any seedsman. Dig the ground deep and manure it well. When planting just press the bulb firmly into the soil. Keep the plants free from weeds as they grow. *Garlic* may be planted out in the same way as the above, taking care to divide the bulbs.

Flowers.

March is a good time of the year to plant out many kinds of bulbs, and no one should be without daffodills, crocuses, snowdrops, sparaxis, ixias, hyacinths, &c. These may all be planted, and the earlier the better—that is, if the soil has been prepared for them. They can be planted singly, in clumps, or in rows, or in any way in which you please or circumstances may require. Daffodils, hyacinths, tulips, crocuses, snowdrops and snowflakes will come to the greatest perfection in the cool climates in this Colony, but they will give great satisfaction almost everywhere. After planting, spread a mulch of cow or horse dung over them. The depths for planting should vary with size and variety—the largest from 3 to 4 inches, and the smallest about an inch. It would be advisable to have the ground properly drained, for bulbs will not succeed in ground too wet. All the charming little flowers—daisies, cowslips, primroses, polyanthuses, auriculas, pansies, and so on—may be planted during the latter part of the month. Violets, too, should not be forgotton, and they, especially the double varieties, come to the greatest perfection in our coolest climates, although the singles succeed fairly well almost anywhere, if there is sufficient moisture for them. Sow some seeds of ten-week stocks in a bed, or in boxes, for transplanting when the seedlings are large enough to move. The plants will flower in the spring. All sorts of hardy annuals and perennials may be sown either in the garden where they are to flower or in boxes or pots. It will probably be the best way to sow in boxes or pots, and afterwards transplant, because seedlings in the garden whilst very young and tender are so liable to injury from insects and other causes. As numbers of the readers of these directions may be new to flower-gardening, and the names are not familiar, they are advised to obtain seeds of some or all of the following:—Anagallis grandiflora, or Pimpernel; Anchusa capensis, hardy perennial; Anterrhinum, or Snapdragon of varieties, hardy perennials; Aquilegea, or Columbine, of various kinds, hardy perennials; Asperula odorata, or Woodruff, a very old English flower, hardy perennial; Auriculas of varieties, hardy annual; Campanulas of variety, hardy perennial; Candyturft of varieties; Coreopsis of varieties, hardy annuals; carnations of varieties, hardy perennials; Centaurea of varieties, hardy annuals; Annual Chrysanthemums of varieties, Clarkia of varieties, hardy annuals; Cosmos of varieties, hardy annuals; Coreopsis of varieties, especially Grandiflora, hardy biennial; Dianthus Heddewigii; Delphinium, or Larkspur, of varieties; Digitalis, or Foxglove; Eschscholtzia, hardy perennial, of varieties; Freesia bulb, but easily raised from seed, will flower the first season; Hedysarum coronarium, French Honeysuckle, hardy perennial; Gaillardia of varieties; Godetia of varieties, hardy annuals, extremely pretty free flowering plants; Senecio elegans, or

Jacobia, hardy annuals; Everlasting Pea; Sweet Pea of varieties; Lobelia of varieties, hardy annuals; Perennial Lobelia, Cardinalis; Linum grandiflorum rubrum, nigella hispanica, or Love in a Mist, hardy annual; Lupines of varieties, hardy annuals; French and African Marigolds; Mignonette, hardy annual; Nemophila, hardy annual; Nasturtium of varieties; Pansies, of varieties, hardy annuals; Penstemon of varieties, hardy perennials; Phlox Drummondii of varieties, some of the prettiest of annuals; Poppies of varieties, hardy annuals; Perennial Poppies; Polyanthus, hardy perennial; Scabious of varieties, hardy perennial; Sweet Sultan, hardy annual; Sweet William; and Wallflower.

The seeds should be sown with care on a finely-prepared surface of soil which has been made fine as well as level. Sow very thin and barely cover with soil. Keep moist, but not too damp. When strong enough plant in the garden.

Cuttings of races, pelargonians, fuchsias, geraniums, verbenas, and many other plants will strike easily this month. Shade well after planting, and keep them moist, but not too damp.

APRIL.

Vegetables.

COOL weather generally sets in during the latter part of April, and we frequently have a good deal of rain; but as long as it is fine it would be advisable to dig up new ground, so as to be prepared for any planting or sowing that may be necessary. Keep the garden quite free from weeds, and take away all old and useless vegetables and remains of vegetables to a rubbish-heap, where they can rot and become useful manure for the garden. If it is thought preferable to burn them, carefully preserve the ashes for spreading over and digging into the ground.

Beans, Broad.—This vegetable may be sown largely from time to time during the month. Johnson's Wonderful and Broad Windsor are both excellent varieties. The dwarf Fan Bean is a good variety, very suitable for small gardens. The rows of this should be about 1 foot apart.

Beans, French or Kidney.—Will only succeed in the warmest parts of the Colony, where frosts are not likely to attack them.

Beet, Red and Silver.—Thin out well the plants which are coming up, and keep the rows free from weeds. It is not advisable to sow any more seed at present.

Borecole or Kale.—A very small quantity of seed may be sown. This is a vegetable hardly worth the growing, for good cabbages are infinitely superior.

Brussels Sprouts, which is a sort of cabbage, is one of the best, if not the best, of that class. A little seed may be sown, and if any young plants are obtainable they should be planted out about 2 feet apart each way.

Cabbage.—Sow seed as largely as may be thought necessary. Plant out, also, any young cabbages that may be available. They should not be pulled out of the seed bed, but taken up carefully, without breaking more roots than can be avoided. The Early Jersey Wakefield and Early Dwarf York are both good small varieties. The Sugar-loaf is also a good kind. Every garden should have a few plants of the red cabbage, which comes in very useful for pickling. If not required for that purpose, it may be eaten in the ordinary way. It should be noted that cabbages are greedy feeders, and need rich soil and abundance of manure.

Cauliflower.—Sow a little seed, and plant out from the seed-bed any strong plants that are large enough to handle. This vegetable should be grown largely, for it is well liked by almost everyone. The ground needs to be well manured, as for cabbage.

Carrot.—Seed may be sown largely. Make the rows about 1 foot apart, and take care not to bury the seed more than half an inch deep. Be careful to weed frequently, for the seed takes a considerable time to come up, and when it does the plants are very fine and tender, and easily destroyed by weeds. Manure had better not be applied, unless it is old and very rotten, as it induces the carrots to become forked and quite spoiled in appearance. Early Shorthorn and Improved Intermediate are good varieties to sow at the present time.

Celery.—Plant out a few seedlings into very well manured ground, if any are available.

Endive.—If plants are available, they may be planted out largely. It is a most useful substitute for lettuce when that cannot be grown. A little seed may be sown.

Leek.—Seed may be sown largely, and any plants from previous sowings that are large enough, say about 6 inches in height, may be planted out. The soil should be heavily manured.

Lettuce.—Sow seed largely, and plant out any young lettuces that are suitable and of sufficient size to handle. The roots should not be broken, if possible, when raising the plants from the seed-bed.

Onion.—Opportunity should be taken now to sow a quantity of seed. Sandy loam is the most suitable soil for the plant. Well-rotted manure should be applied in quantity, the land well drained. and the surface kept somewhat raised and made clean and fine for the seed. The beds should be narrow, so that they can be easily weeded. It must be kept in mind that weeds have a most damaging effect on young onion plants, and should never be allowed to grow and attain any size. The seed should be sown in drills, which should be about 1 foot apart. Care must be taken not to bury the seed deep—indeed, it should be little more than pressed into the soil. Sow thin, unless small onions are required.

Parsley.—Sow a small quantity of seed, in order to keep up a supply of plants.

Parsnip.—Sow a few short rows. The ground should be dug deep, as the roots will extend to a great depth if the soil is free and open.

Peas.—Take the opportunity to sow largely of this general favourite in rows about 3 feet apart. Cover the seed with soil to a not greater depth than 3 inches. The peas should be sown in the drills about 3 inches apart. For manure, use well-rotted droppings from farm animals. Lime, especially sulphate of lime or gypsum, will be found useful. Potash and superphosphate of lime are good manures to use.

Radish.—Keep on sowing a very little seed from time to time, and root out all old tough plants. Use plenty of well-rotted manure.

Spinach.—A little seed may be sown occasionally during the month. Sow in rows about 18 inches apart, and thin out the young plants well when they come up. Use well-rotted manure freely.

Shallots.—Plant out a few bulbs, but do not set them deep in the ground. They should stand about a foot or so apart each way. Whatever distance you may think best keep to it, or else everything will have a most unsatisfactory appearance, and be awkward to work. A line should be used on every occasion.

Herbs.—Sow a little seed of any kind it may be wished to grow.

Flowers.

The greatest favourite amongst the flowers is, beyond all doubt, the Rose, and no garden can be complete without a few good kinds. There are numerous classes of Roses, some well defined, others difficult to define, but, as a rule, they can be fairly well distinguished. The classes most generally known are the Hybrid perpetual, the Tea-scented, the Hybrid tea-scented, the Bourbon, the Noisette, the Polyanthas, the Damask, French or Gallica, and the Banksian. Of these the best for general purposes are the Tea and Hybrid tea-scented. They blossom with wonderful profusion, and are exceedingly beautiful. In most parts of the Colony they will continue in bloom for the greater part of the year. The Hybrid perpetuals flower chiefly in the spring and again to some extent in the autumn. The flowers are brilliant, large, and good, and, as a rule, much darker flowers can be obtained amongst them than amongst the teas. A list of some of the best of the various classes will be given to enable any one to give an order to a nurseryman. They will cost from about 1s. 6d. to 2s. each. Of the tea and hybrid-teas some of the best and most useful are—Comtesse de la Barthe, Countess of Pembroke, Climbing Devoniensis (a very strong grower), Etoile de Lyon, Grace Darling, Hon. Edith Gifford, La France, Lord Tarquin, Madame Camille, Madame de Watteville, Madame Hippolyte Jamain (one of the best), Madame Bérard, Marie van Houtte (perhaps the best for general purposes), Climbing Niphetos (a beautiful white), Souvenir d'Elise Vardon, Saffrano (an old but useful variety), The Bride (an exceedingly beautiful one), and The Meteor. Of the Bourbon class the old Souvenir de la Malmaison is one of the best roses in cultivation, and one of the most constant to produce flowers. Mention should have been made of the hybrid tea-climbers, which are very beautiful and useful—Reine Marie Henriette, Souvenir de Madame Mètral, and William Allan Richardson. Some of the best hybrid perpetuals are—Alfred Colomb, Beauty of Waltham, Captain Christy, Charles Lefebvre, Duke of Edinburgh, Earl of Dufferin, General Jacqueminot, Her Majesty, John Hopper, Mrs. John Laing, Paul Dupuy, Pierre Notting, Paul Verdier. Of the Noisettes—Lamarque, Céline Forestier, Maréchal Niell, Cloth of Gold, and Reverend T. C. Cole. The above are all good roses, and there are numbers and numbers of others perhaps equally useful and beautiful.

Now the ground should be in good heart for roses, for, although they will adapt themselves to some extent to a variety of conditions and will endure a great deal of ill-treatment and neglect, it is not possible to obtain the most satisfactory flowers unless the plants are well treated. The best manure to use is a mixture of the droppings of farm animals, including the pig. If these be well rotted together and applied to the roses the flowers should be excellent, and the pleasure to be derived from their cultivation will be exceedingly great. The situation for roses should be open, but well sheltered, for they do not like strong bleak winds. The tea-scented varieties can be planted at any time, preferably before the winter sets in, or else towards the spring. The hybrid perpetuals towards the end of winter. When planting make holes large enough to enable you to spread out the roots. Trim all broken and bruised roots with a sharp knife, and then plant carefully, shaking the soil well amongst the roots, and when well filled in, press firmly with the feet. In case the plants are at all shrivelled up when received, unloose the bundle, and bury the whole, roots and branches, in some moist soil for a day or two, and if not too far gone, they will quite recover. If the soil be very dry when planting, give a gallon or two of water to each plant when the hole has been half filled with soil.

The carnation is another most desirable and easy plant to grow, besides being a great favourite with everyone. The best carnations to plant are those known as the Perpetual Flowering or Tree Carnations. These bear flowers very often during the year. The plants will need attention in tying up to stakes, and they must not be allowed to suffer from drought. If plants can be obtained they may be planted out during the month. Bouvardias are most beautiful and useful flowering plants, which may be planted out this month in all but the coldest districts. They will do well in any good soil.

Spring flowering bulbs, including daffodills, should be planted as soon as possible.

Cuttings of roses, fuchsias, verbenas, carnations, and many other kinds of plants should be put in without delay, and they will probably strike root very soon, but they had better not be moved and planted for some time to come. The more sandy the soil the better for the cuttings, which should be protected to some extent from the sun, but they must not be shaded too much.

Seeds of all kinds of hardy annuals may be sown now, and the sooner the better, so that the seedlings can be planted out before the winter sets in. Good seed of annuals and perennials can be obtained so cheap that for a very small sum of money a most beautiful collection of flowers can be obtained. Some care is necessary in sowing the seed, and in the rearing of the seedlings, but a little attention and practice will soon enable anyone to become successful.

Flowers can be so easily grown in this Colony that there is no excuse for anyone to be without a few. The best way to raise plants from seed is to sow in boxes or pots, or even old kerosene tins or jam tins, but these boxes or tins must have holes knocked in the bottoms to allow surplus water to drain through. Before putting soil in these boxes, &c., be sure to put in some drainage material, such as broken-up bricks, charcoal, small bones, &c., say an inch or two deep, and then fill up with soil of a light, friable nature. Be extremely careful not to sow any seed deep; very fine seed should be hardly covered at all—merely a little fine soil sprinkled over it, and this should be pressed down lightly. Before sowing seed it would be advisable to water the soil well, and then to let it stand for a short time to settle down. Sow thinly, and do not waste seed. The chances are that a good deal of the seed you sow will not come up.

Sow seeds of the following different kinds of annuals and perennials, and after the seedlings have grown to the height of an inch or so they may be planted in the garden carefully:—Snapdragons of varieties, columbines, everlastings, dwarf asters, daisies, coreopsis, campanulas, candytuft of varieties, Canterbury bells, cornflowers, cowslip, larkspur, eschscholtzia, everlasting peas, forget-me-not, gaillardia, godetia, holyhock, lavender, lupines, marigold, stocks, mignonette, dwarf nasturtium, love-in-a-mist, pansy of varieties, sweet peas, penstemon, phlox Drummondii, polyanthus, scabious, sweet William, and wallflower. These are some of the easiest, and some of the prettiest, plants to grow.

MAY.

Vegetables.

Asparagus.—Advice was given last month to have some ground made ready for this good vegetable. If this work has not been done, set about it as soon as possible, and do not delay it until the planting season.

Artichoke (*Globe*).—A vegetable hardly worth the growing. It is a cultivated form of the wild cardoon, a native chiefly of the Mediterranean sea-coast. Plants or suckers may be planted at any time during the month. The soil should be a rich sandy loam, moist, but well drained, for this vegetable to come to perfection. Half-a-dozen plants will probably be enough to grow. They may be planted in a row about 3 to 4 feet apart. The artichokes will succeed fairly well on most soils, if not too dry, provided the ground be well manured.

Beans, Broad.—Seed may be sown largely, at intervals during the month, in order to keep up a constant supply. It needs a good deal of moisture, and is a very suitable vegetable for cool districts, quite unlike the French bean.

Beans, Kidney or French.—Should only be sown in the warmest parts of the Colony, where frosts are not likely to occur. Old plants should be cleared out of the garden immediately they cease to be productive.

Brussels Sprouts.—Sow a little seed during this month in a seed-bed, or even in a box, in order to have some plants coming on for successional planting. If strong plants can be obtained they may be planted out.

Cabbage.—Sow seed of several varieties, as recommended before, once or twice during the month. If strong seedlings are available, plant them out.

Cauliflower.—Sow a little seed occasionally, and plant out strong seedlings, a few at a time.

Carrot.—Sow a little seed occasionally in drills about a foot to 18 inches apart. Sprinkle the seed thinly along the shallow drills, and cover by hand with fine soil.

Celery.—Sow a very little seed, and plant some good strong seedlings in shallow trenches. Apply a heavy dressing of manure before planting.

Endive.—This is a plant rather like lettuce in appearance, and it is used as a salad. Sow a little seed, in the same manner as you would lettuce, and afterwards transplant the seedlings when they are large and strong enough. The soil should be made rich, for the plants should be grown quickly, so as to have them tender.

Leek.—Sow some seed, and plant out the seedlings when they are 8 inches or so in height. The ground must be made very rich to grow the leek to perfection, for it is a greedy feeder.

Lettuce.—This is a good time to sow seed, and also to plant out strong seedlings from previous sowings. Move the plants without breaking any roots if possible. The great object to attain is to grow them without a check, and this can be done if they are carefully taken out of the ground and carefully planted. Make the soil rich with well-rotted manure.

Onion.—The ground should be made rich and worked fine on the surface, and particular care should be taken to have the beds well drained. Sow in rows, and barely cover the seed with fine soil. Keep the beds quite free from weeds, and, to facilitate weeding, the beds should be made narrow. Soot mixed with salt half and half makes a useful top-dressing sprinkled amongst onions when they come up.

Parsley.—Sow some seed of this useful plant.

Parsnip.—Sow a little seed in drills. This is a deep rooting plant, and therefore the soil should be deeply worked.

Peas.—Keep on sowing a row or two from time to time, in order to keep up a continual supply if possible, for it is hard to find a better vegetable than the pea. Sow in rows about 3 feet to 4 feet apart. The drills shall be about 3 inches deep, and the peas about 3 inches apart in the drills.

Radish.—Sow a little seed frequently in order to keep up a supply.

Sea Kale.—Sow a very little seed.

Spinach.—Sow a little seed.

Shallots.—Plant out some bulbs or cloves in rows about 12 to 15 inches apart. Do not bury the clove deep, but just press it firmly into the soil.

Herbs.—Sow seed and lift; divide and replant old plants.

Flowers.

In all the warmest parts of the Colony evergreens, or those plants which retain their leaves during the winter, may be planted out. It is always as well to plant evergreens early in the autumn, so that they can be established to some extent before cold weather sets in. Of evergreen plants one of the best known is the camellia, of which there are many beautiful varieties. This shrub is an easy one to grow in very many parts of the Colony, and may frequently be seen in gardens; but the variety most commonly to be met with bears flowers of but a poor quality. Some of the best varieties to grow are—Alba Plena, a pure white; Adele Pelagi Medicis, white marbled with pale pink; Augustina Superba, clear rose; Bealii, deep crimson; Comte de Gomer, rose striped with crimson; C. H. Hovey, dark crimson; C. M. Hovey, beautiful bright crimson; Comtessa Lavinia Maggi, pure white and rosy-cerise; Cup of Beauty, pure white and rose; Dryade, rose; Duchess of Berry, pure white, one of the very best; Harriet Beecher Sheather, raised in the Colony, rosy salmon, one of the best; Henri Favre, salmon-rose; Isabella, pure white, an excellent variety; Lady St. Clair, pale flesh pink, a most beautiful camellia; Lowii, rich crimson; Prince Frederick William, raised in the Colony and one of the best, rich rose. One cannot go wrong in making a selection from the above. The prices will vary from 1s. 6d. to 2s. 6d. each.

The camellia, named after a Moravian Jesuit, G. J. Camellus, is a fairly hardy plant, native of China and Japan, and belongs to the same natural order of plants as the tea. Throughout the coast districts the camellia thrives to perfection, and in colder parts of the Colony, when not exposed to cold winter blasts, it grows well. When selecting plants do not choose large ones. Small plants, well rooted but not pot-bound, are the best. In good soil and favourable situations camellias attain a considerable size; therefore, under such circumstances, allowance should be made and sufficient space provided.

Bouvardias, at this season of the year are to be seen in perfection. They will succeed best in warm situations in almost any kind of soil, provided it be fairly moist but well drained. In warm districts they may be planted out this month, but if they do not become well established before winter sets in, they are liable to die.

All the varieties are pretty, but the best are—President Garfield, double pink; Alfred Neuner, double, pure white; Hogarthi flore plena, double scarlet; Sang Lorrain, double crimson; Bridal Wreath, pure white; Candidissima, pure white; Humboltii corymbiflora, sweet-scented, pure white; President Cleveland, scarlet, one of the very best; Laura, deep pink; Maiden's Blush, blush pink; Priory Beauty, satin rose; Triomphe de Nancy, double salmon; and Victor Lemoine, double red.

Hardy annuals—that is, plants which live for one season only (although in some parts of this Colony many plants which are annual in cold climates continue to live for more than a year)—and hardy perennials, or plants which live for many seasons, may be sown here and there about the garden, or else in pots or other convenient contrivances, as suggested last month. Any seedlings that came up last month, and appear to be large enough and strong enough to move, may be planted out, taking care to shade and water them until they are well established.

If anyone has an old overgrown neglected garden, and who wishes to start afresh after reading these notes, had better make a wholesale clearance of all useless ill-shaped trees and plants, trench the ground, and dig in a heavy dressing of farm-yard manure.

Bulbs planted last month and previously will soon start into growth, so when clearing, hoeing, or raking the garden, care must be taken not to injure the young tender shoots.

JUNE.

Vegetables.

ALTHOUGH we are now in mid-winter, the winter in this Colony is generally so mild, when comparing it to such winters as those experienced in Canada, other parts of North America, and the northern portions of Europe, that we have no difficulty in raising a sufficient supply of nearly all the best sorts of vegetables that can be grown.

Artichoke, Globe.—Some suckers or young plants may be put out during the month, but this may be delayed, if necessary, until nearer spring. Plant about 3 feet apart, and if the soil is dry they had better be well watered after planting.

Artichoke, Jerusalem.—This is quite a different vegetable to the above, and in no way related to it, and, properly speaking, is not an artichoke at all. It is a native of Brazil. It is a remarkably easy vegetable to grow, and will succeed on almost any kind of soil if it be well dug and well manured with old rotten manure. Over-manuring is apt to cause the stalks to grow too rank, and then the tubers will not be so plentiful. It is an excellent vegetable, as well as a wholesome one, and it should be grown in every vegetable-garden. The tubers had better be planted as soon as they can be obtained, as they will not keep out of the ground for any length of time. Make rows about 3 feet apart, and plant the tubers along these rows about 1 foot apart, and about 5 inches deep. Cover with soil and keep free from weeds. Endeavours are being made by seedsmen in Europe to raise tubers as smooth as possible, and it is most probable their efforts will be successful.

Beans, Kidney.—These may be sown in the warmest parts of the Colony, and only in places free from frosts.

Beans, Broad.—The present month, June, is a suitable time to sow to any extent. This vegetable prefers a stiff soil, but will succeed fairly well in any soil if it be well manured. Sulphate of lime will be found to improve the quality of the beans considerably. Superphosphate of lime is also useful. Manures rich in nitrogen should be avoided.

Cabbage.—Sow a sufficient quantity of seed to meet requirements. Sow also some seed of the red or pickling cabbage, for it will be found to be useful. The pickling may be done without any difficulty. The cabbage should be cut up into fine cross-slices, and covered well with salt for about three days or more. The salt should be rubbed well into the cabbage occasionally. Then place the cut-up cabbage in pickle-jars, and pour in and cover with boiling vinegar. Allow it to cool, and then cork the bottles securely. This may be used at once. Cabbages may be planted out as required.

Endive.—Sow a little seed in the warm parts of the Colony. It is a native of a warm climate, and therefore succeeds well in warm places, although some varieties will grow well almost anywhere.

Carrot.—Sow a few rows of this useful vegetable, and thin out former sowings. The small carrots thinned out need not be thrown away, for they can be used in soups. Try Early Shorthorn variety.

Leek.—This is a good, useful, and wholesome vegetable, and should be grown largely. Sow a good quantity of seed in a seed-bed. If any fair-sized seedlings are available, plant them out in very richly-manured shallow trenches. Some of the best varieties are London Flag and improved Musselburg. The trenches should be about 18 inches apart, and the young leeks should be planted deep in the soil, about 9 inches apart. The leek is a greedy feeder, and needs abundance of manure and water to bring it to the greatest perfection.

Lettuce.—Sow a little seed, and plant out strong seedlings from the seed-bed. Remove them carefully, and, if possible, without breaking their roots.

Onion.—Sow a little seed, and attend to seedlings which are coming up from former sowings. They must be kept quite free from weeds. Thin out as the plants become strong. Spread a dressing of soot and salt, half and half, about the young onions.

Parsnip.—Sow a little seed; thin out former sowings, and keep down the weeds as they grow.

Peas.—Sow largely, in rows about 3 feet apart. When the plants are about 3 or 4 inches high stick in some light brush or sticks along the rows for the peas to climb over. Be careful not to make the brush too dense and thick or the plants cannot grow. The seed should be put about 4 inches apart in drills, which should be about 3 or 4 inches deep, but not more.

Radish.—Sow small quantities of several sorts. Some are round and others long. Use them before they become large and hard.

Herbs.—Divide any old plants and replant.

Salad Plants, such as mustard and cress and radishes, may be sown from time to time as required. Tender radishes are always useful, but all that are hard, pithy, or overgrown should be pulled up and thrown to the pigs or chickens.

Flowers.

During the month of June a great deal of useful work can be done towards making new gardens. Wherever the leaves have fallen from roses and other deciduous plants, such plants may be removed and replanted. Plants ordered from nurserymen may arrive during the month, and these should be planted out as soon as it can be done. When planting, examine the roots of each plant, and remove with a sharp knife all that are broken and bruised and make as clean a cut as possible. The pruning of roses should be deferred, especially in the cold districts, until just before spring begins.

This is a good month to clear out rubbish from old overgrown gardens. Apply a good, heavy dressing of manure, and dig it in amongst those plants which are worth preserving.

The ever-popular carnations may be planted now or at any time of the year convenient. Those known as the tree or perpetual-flowering varieties are the most satisfactory to grow, as they bear flowers nearly all the year round. These plants will succeed in almost any kind of soil, provided it be well dug, drained, and manured with rotten farmyard manure. They will not stand severe drought, but they can be preserved if mulched and watered.

JULY.

Vegetables.

THE month of July is generally very cold throughout New South Wales, especially in the elevated parts where there is but little growth in most plants, but for all that they should be attended to and kept weeded, for weeds of some kind generally manage to grow. All spare ground should be turned up with a spade and be left in a rough state, so as to expose as much surface as possible to frosts, rain, snow, and sun. Dig the ground deep, and if it be not naturally sufficiently rich it must be well manured, with rotten farmyard manure made from the droppings of animals, except the pig, mixed with straw, old leaves, or any other vegetable matter. The more of the liquid excrement of animals that can be obtained and mixed with the manure the better it will rot, and the more valuable it will be.

Asparagus.—Preparation should be made for planting this desirable and wholesome vegetable. The planting had better be delayed until next month in the coldest upland districts of the Colony, or it may be delayed even later, so long as the buds or shoots have not started into growth. But it is highly desirable that the ground be made quite ready without delay, and the planting can be done at convenience.

Jerusalem Artichoke.—The ground should be well dug, well drained, and well manured. Small tubers may be planted whole, and large ones may be divided and planted if supply is scarce. Plant about 5 inches deep, about 1 foot apart, in rows 3 feet to 4 feet apart.

Bean, French.—In the warmest sub-tropical portion of the Colony it is quite possible to grow this vegetable all the year round, but it is useless sowing it where any frosts occur.

Broad Bean.—Sow a few rows for succession during the month. This plant requires deep soil to enable it to come to the greatest perfection, for its roots will extend to a considerable depth when they have good open, deep soil. At the same time the soil should be well drained, as excessive moisture is injurious to it.

Broccoli.—Seed may be sown largely in small beds, and the seedlings transplanted when the young broccolis are large enough. Sow thinly in little drills and water occasionally, and on no account allow the beds to become very dry.

Cabbage.—A little seed may be sown in a seed-bed or box. Sow in little drills 2 inches or so apart, and do not use too much seed. Try several kinds of seed to ascertain which variety succeeds best in your district. If you have any good strong seedlings, transplant them to some well-manured ground that has been prepared for them.

Cardoon.—Is a vegetable worth testing for it is much liked by some persons. It belongs to the Globe Artichoke family and somewhat resembles that vegetable, but the tender leaves of the heart of the plants are eaten and not the flower buds as in the case of the artichoke. The seed is sown in spring and the seedlings are afterwards transplanted to well-manured beds, but this transplanting must be done very carefully or else the seedlings will die. It is the custom to sow seed in well-manured trenches, like celery trenches, and when it comes up, to thin the plants out to about 18 inches or 2 feet apart. The plants need good supplies of water and rich soil. When they have attained a good size they will need earthing up like celery in order to blanch their hearts. Leaves or straw should be tied round each plant before earthing up so as to prevent any soil dropping in amongst the leaves.

Carrot.—Sow a little seed in drills about 1 foot to 18 inches apart. Thin out when the plants are large enough and keep quite free from weeds.

Cauliflower.—Sow a little seed to keep up a supply and plant out any strong young seedlings you may have on hand.

Cucumber.—In the warm coast climates sow a little seed in a sheltered position. It would be advisable to protect the bed at night with some bagging or other material, for fear of chance frosts or severe cold.

Capsicums or Chillies.—May be sown and protected as recommended for cucumbers.

Egg plants.—Seed may also be sown in the warm districts.

Leek.—Sow a little seed to keep up a supply. Plant out good strong young leeks to well-manured trenches and keep them well watered if the weather and soil are dry.

Lettuce.—Sow a little seed and plant out strong seedlings to well-manured ground.

Onion.—Sow a good quantity of seed on well-manured and well-drained narrow beds where the seedlings can be weeded easily without treading amongst the plants. Sow in drills and cover the seed very lightly with fine soil.

Parsnip.—Sow a little seed.

Peas.—These may be sown largely in rows from 3 to 4 feet apart according to the height of the variety. For the higher it is likely to grow, the wider apart the rows should be.

Savoy.—Sow a little seed in a seed-bed. If any strong seedlings are available they may be planted out. The soil should be well manured before planting.

Spinach.—Sow a little seed in drills 2 feet apart and thin out the plants when they come up to about 1 foot from plant to plant.

Swede turnip.—Sow a little seed in drills.

Tomato.—Seed may be sown in the warm climates, but protect at night.

Turnip.—Sow a little seed in drills.

Flowers.

All sorts of herbaceous plants, that is, those plants which are perennial and which lose their stems every year, although their roots are alive, may be divided and replanted. To this class of plants belong chrysanthemums, delphiniums or perennial larkspur, perennial phloxes, pentstemons, and some of the salvias. The term "perennial" means a plant that lives for more than two years.

Roses, carnations, pinks, and all kinds of hardy plants may be transplanted, and the garden should have a dressing of rotten farmyard manure forked neatly in, after it has been well cleaned up. But great caution should be taken not to disturb any bulbs that may be just starting into growth. In the warm parts of the Colony, which are not subject to frosts, seeds of tender annuals may be sown, as well as hardy annuals, if the latter were not previously sown. The following annuals and perennials are well worth growing:—Amaranthus of varieties, beautiful ornamental-leaved annuals, Anagallis, Anterrhinum (snap dragon) of varieties, Columbine of varieties, Armeria or thrift, Asters of varieties, rather tender, Auriculas for cold districts, Browellia alata, Calandrina, Coreopsis of varieties, Campanula (Canterbury bell) of varieties, Candytuft of varieties, Carnations of varieties, Celosia or Coilescomb, Cornflower, (*Centaurea*), sweet Sultan (*Centaurea moschata*), Chrysanthemum (Marguerite), Clarkia elegans, Cobæa scandens, a useful, strong-growing creeper, Cosmos of varieties, Cowslip, Daisy, Dahlia, Datura, Delphinum or Larkspur, Dianthus, Garden Pinks of varieties, Digitalis or foxgloves, Eschscholtzia of varieties, Everlasting Pea, Gaillardia, Gomphrena or Globe Amaranthus, Godetia of varieties, Pansy, Helichrysum (everlasting) of varieties, Sunflower of varieties, Hollyhock of varieties, Honesty, Iponopsis elegans, Sweet Pea of varieties, Linum coccineum, Scarlet Flax, Lobelia of varieties, Lupins of varieties, Marigold, French and African, Maurandia alba and rosea (climbers), Mignonette, Myosotis (forget-me-not), Nasturtium of varieties, Nemophila, Nigella damascena (love in a mist), Poppy of varieties, Pentstemon, Phlox drummondii, Picotees, Polyanthus, Stocks of varieties, Scabiosa, Verbena, Virginian stock, and Wallflowers. If these are sown in the cool districts they will need protection from frosts. If no means of protection are available the sowing had better be delayed.

AUGUST.

Vegetables.

In many parts of the Colony spring may be said to begin, but in colder parts the weather is still wintry, and frosts frequently occur. Take every opportunity of destroying young weeds, for many of the worst of them begin to grow about this time of year, and the best chance to get rid of them is to tackle them whilst they are quite young.

Take every opportunity to prepare for spring sowing and planting, for during next month nearly all the tender sorts of vegetables may be sown even in the coolest climates. Make a thorough clearing away of rubbish, such as old cabbages, peas, and useless vegetables of all sorts. When these have been cleared off, spread a good dressing of manure, and dig it in, taking care to dig the beds as evenly and level as possible. Nothing can be worse than a bed all heaps and hollows, and it requires but little practice to dig well, if proper attention is given to it and the work be not too much hurried. During the month the following vegetables may be planted and sown:—

Asparagus.—Roots had better be planted as soon as possible, because before long, and especially in the warmer parts of the Colony, the buds or shoots will begin to start into growth.

Artichoke, Jerusalem.—Before it is too late, obtain some tubers and plant them out in trenches made about 6 inches deep, and 3 feet apart. Drop the tubers along these trenches, about 1 foot apart, and cover with fine soil. The ground, before making the trenches, should be well dug, well drained, and well manured.

Beans, French or Kidney.—As this is a vegetable generally well liked, and comparatively easy to grow, when the frosts are over a few rows should be sown in the warm parts of the Colony. Where there is danger of frost it is not worth while risking the sowing, as the vegetable is tender and cannot stand frost.

Beet, Red.—Sow seeds in drills 18 inches apart, and about 1 inch deep. Cover the seed by hand with fine soil, and firm down with the back of a spade. When the plants come up and are 3 or 4 inches high, thin them out by degrees to about 9 inches or even a foot apart.

Beet, Silver.—Manure the ground well with farmyard dung, and then sow the seed in the same way as directed for red beet. Thin out the plants well to about 18 inches apart, and keep them free from weeds.

Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Savoy.—These vegetables require much the same treatment, and are therefore classed together. They belong to the same family, but have been altered by selection and cultivation. Make small seed-beds, digging the soil fine, and keeping it as level as possible. Sow a little seed thinly in small drills about 2 inches apart. The Brussels sprouts, broccoli, cauliflower, and Savoy will be found to succeed best at this season of the year in the coldest parts of the Colony. When plants are available, they may be planted out from 2 to 3 feet apart, according to the richness of the soil. The richer the soil, the wider apart the plants should stand. The ground should be well dug and well manured. In order to produce good cabbages, cauliflowers, &c., the seedling plants should be lifted carefully from the seed-beds, taking care not to break their roots. They should then be planted out carefully, kept well weeded, and well cultivated frequently.

Celery.—Sow some seed in a small carefully-prepared seed-bed, or in a box of good fine soil mixed up with some old dung. When the plants have grown to a height of about 2 inches, move them to a small bed which has been well prepared and the soil made fine. Then plant out in this bed, about 3 inches apart, the young seedings when they have grown to a height of about 2 or 3 inches, and they will develop into strong sturdy plants, ready for transplanting into trenches. Celery needs abundance of manure and good supplies of water.

Cardoon.—If plants can be obtained they may be planted out at the present time or later on in the spring. If no plants are available seed must be sown. Plant about 3 feet apart each way. The usual method of blanching the leaves is to tie all the leaves together some time before the vegetable is required for use, and then tie bagging, or, better still, straw round the whole. The soil should be made rich by heavy manuring, and the ground should be trenched. "The cardoon is excellent when stewed like celery, the centre or heart only being used, and not the grosser outside leaves, which, though they may be well blanched, should be rejected. During the cooking process let the water used to boil it in be abundant, in view of removing a somewhat bitter flavour when badly cooked."

Celeriac or Turnip-rooted Celery.—This is a variety of the ordinary celery, but the root has become, by cultivation and selection, like a turnip in appearance, and this turnip-like root is used instead of leaf stalks. It is a useful vegetable, especially for soups and stews, and can be easily grown. The soil should be rich, well manured, rather moist and light.

Carrot seed may be sown largely in soil that should be prepared in the same way as that recommended for red beet.

Cucumber.—Sow some seed under shelter, and plant out the seedlings when they have become strong plants. Frosts are likely to kill them if they are not protected at night.

Leek.—Sow a little seed in a seed-bed, and when the seedlings have grown to a height of 6 or 8 inches they may be transplanted. The seed should be covered very lightly with soil—in fact, barely covered.

Lettuce.—Sow a little seed in a seed-bed, and plant out the seedlings when they are large enough to handle. If plants can now be obtained, they should be planted out. Do not break the roots more than can be avoided.

Melons, Cucumber.—Seed may be sown in warm spots, where the young plants can be protected from frosts. When all danger from frost is past, the seedlings may be transplanted out to the garden.

Onion.—Sow seed largely of this important and wholesome vegetable.

Parsnip.—Sow largely in drills as was directed for beet-sowing. The ground should be dug deep, but it would not be advisable to apply manure.

Peas.—Should be sown largely in well-prepared ground that has been well manured with rotted dung. Avoid the use of manures containing a large proportion of nitrogen, such as sulphate of ammonia. If artificial manure has to be used, apply superphosphate of lime two parts, and kainit, or potash manure, one part, at the rate of about a large handful to the square yard. Fine ground bone-dust is a good manure to apply, and lime, rubbish, and wood ashes are useful. Sow the peas in drills, about 3 feet apart, and cover with about 3 inches of soil. The peas should not be sown closer together than 4 inches. As soon as the peas are well up above the ground put in sticks along the rows to support the plants from trailing over the ground. Keep the ground between the rows frequently hoed.

Potato.—Plant a few rows of a kidney variety or the Early Rose; or if these cannot be procured, try any other kind available. Use fair-sized whole potatoes in preference to cut sets.

Radish.—Sow a few rows of various kinds in soil made rich with well rotted manure.

Rhubarb.—This is a most useful plant to grow. It needs rich, heavily manured, well-drained, and deeply-dug soil. Plant out roots if they can be obtained, 3 or 4 feet apart. The crown of the plant should be about 2 or 3 inches below the surface of the soil when covered up. If plants are not easily obtainable, seed may be sown next month, but the plants will not be ready to put out for some time.

Salsify or Vegetable Oyster.—This is but seldom grown in the Colony, but it is a good vegetable, and useful for a change. It needs a light, rich soil for its fleshy roots, but fresh manure should not be used. Sow the seed in rows about 15 inches apart, and when the plants come up thin them out to about 4 or 5 inches apart.

Turnip.—Sow a little seed in drills, about 1 foot or 15 inches apart. Cover the soil with not more than an inch of fine soil. Manure with stable dung, superphosphate of lime, or fine bone-dust.

Tomato.—Sow a little seed in a warm, sheltered place and protect from frosts. When there is no danger from frosts, seed may be sown in the garden without protection, and if plants can be obtained they should be planted out.

Flowers.

During the month of August flowers of many kinds should be abundant in all gardens where spring may be said to begin. The jonquils and daffodils, which are favourites, and very justly so, with everyone, should be blooming freely. The best kinds are now becoming plentiful in the Colony, and can be obtained, in the proper season, at very cheap rates. A few years ago they were unobtainable. They need but very little care in cultivation, provided they are not smothered by weeds, and may, therefore, be grown in abundance by even the laziest of gardeners. Other bulbs are also in flower, such as the snowflakes and the sweet-scented *Freesia refracta*, a pretty flower and most easy to grow. Then the Anemones and Ranunculuses are beginning to put forth their brilliant flowers; and tulips will be abundant in the early spring. All sorts of tender annuals may be sown this month except in those districts where very late and heavy frosts are likely to occur. Of these the following are pretty and well worth growing:—Acrocliniums, roseum, album and grandiflorum—pretty everlastings, and easy to grow; amaranths (plants related to the coxcombs). Most of these are chiefly grown for their beautiful variegated leaves. The Globe amaranth, which bears purple everlasting flowers, classed botanically as Gomphrena, is a useful plant, and particularly suited for growing in a mass. The true coxcomb (*Celosia cristata*) bears the well-known peculiar flower-heads; this plant needs a warm situation—indeed, all the family of amaranths will thrive best in warm situations. There are many varieties of *Celosias*, but their flower-heads are more open—in fact, become spikes or masses of spikes, and these to some persons are much more preferred than the coxcomb. Some of the best varieties are C. *cristata coccinea*; C.c. *comosa*, C.c. *variegata*, C.c. *Huttonii*, and others. The Antirrhinum, or snapdragon, is a useful flowering herbaceous plant. There are numerous varieties—some tall-growing, that is, up to about 2 or 3 feet, and others are dwarf. The latter are pretty little plants, useful for small, but well worth growing in all gardens. The Antirrhinum is, perhaps, one of the most useful plants to grow for general purposes, for it is nearly always in flower; that is, it will be if you take the trouble to cut back the old flowering spikes before the seed ripens. Aquelegia, or Columbine—another well-known plant of easy management. There are many varieties, and some of them bear exceedingly pretty flowers. Other useful plants, the seeds of which may be sown:—Asters, Balsams, Bartonia, Browallia alata, Coreopsis, Campanula or Canterbury Bell, Candytuft, Carnations, Cornflowers, Marguerite, Chrysanthemums, Clarkia, Cosmos, Single Dahlias, Datura, Larkspurs, Dianthus, Foxgloves, Eschscholtzia, Gaillardia grandiflora, and other varieties, Helichrysum, Sunflowers of varieties, Hollyhocks of varieties, Honesty, Ipomopsis elegans, Sweet Peas, Linum coccineum, Lobelias, Lupins, Maurandia alba and rosea both creepers, Mignonette, Forget-me-not, Nasturtium, Nemophila, Pansies, Petunias, Phlox Drummondii of varieties, Picotees, Portulaca, Rhodanthe, Salpiglossis, Salvia, Saponaria, Scabiosa, Stocks, Tagetes (marigolds), Verbena, Virginian Stock, and Zinneas.

Obtain some of the many beautiful varieties of Irises, including some of the Japanese. These bulbous and creeping rooted plants will succeed best in moist situations, but will flower well under ordinary conditions if they are not allowed to become very dry. They need the sun, and will not succeed well in a shady place. There is a variety of Iris fœtidissima, bearing variegated leaves, which makes a very ornamental plant. It is not frequently met with in this Colony. The Japanese species is known as *Iris Kæmpferi*. There are many varieties of this of great beauty, which are becoming very popular, and deservedly so.

If Bouvardias were not planted early in the fall they should be planted during August or the early part of September if the soil is not too dry. However, although the soil may be very dry, you can plant if you have a good supply of water, and use it in sufficient quantity to keep the plants from flagging. Camellias may also be planted as well as other evergreens. Use some shading if the sun is very hot at midday. An old shingle or two or a little brush will answer very well, but the plants should not be overshaded, or else they will become weak and may die off. Prune roses, and do not be afraid to use the knife well. The usual advice for pruning roses is to prune back hard all those kinds which do not make strong growth, but do not prune back so hard the vigorous growers, or else they will produce too much wood at the cost of flowers. The first thing to do is to cut out clean all dead wood, then if the plants seem to be too crowded cut out clean the crowded shoots, then cut back the remaining branches, and endeavour to make a well-balanced plant and a neat job. To become a really good rose grower one must learn from experience and observation. Use a sharp knife in preference to shears, and do not be afraid of a few scratches from the thorns. When the pruning is finished, gather up all the prunings and burn them, then clear away weeds and fork up the ground between and around the plants. If you are not a good hand with a fork, and keep tearing and dragging up the roots as you dig, you had better use a sharp spade, for it is better to cut the roots than drag and tear them about. You need not dig up the ground more than 2 or 3 inches deep, and if you stick to this depth you will not cut many roots. When you have finished this work spread a mulch of dung all over the bed about 2 or 3 inches deep. If you have, say, fifty roses planted 3 or 4 feet apart, you will require a good deal of dung, but, of course, this should be plentiful on every farm. The rose is one of the most interesting and beautiful flowers it is possible to grow, and the best kinds for general purposes are those known as the tea-scented and hybrid teas, for they will be nearly always in blossom if the seed-vessels are cut off as soon as the flowers fade away.

SEPTEMBER.

Vegetables.

In many parts of the Colony the ground begins to get sufficiently warm for vegetables of a rather tender nature, and consequently it would be advisable to sow seeds of as many varieties of useful vegetables as would be likely to thrive. It is a mistake to depend on one or two kinds, such as cabbages and pumpkins, which are apparently the most generally grown in the country, when vegetables are grown at all.

Asparagus.—It may not be too late in cold districts to plant this useful vegetable. If the plants have not begun to shoot they may be safely moved from the seed-bed to their permanent bed.

Arrowroot.—If you have sufficient space in your vegetable garden, plant out some tubers of arrowroot, provided your locality is in one of the warm districts of the Colony. This plant may be seen in patches in many gardens growing without the slightest care, and probably no use is made of it, possibly for a want of knowledge as to how to obtain the starchy matter from the roots. There should be no difficulty in making excellent arrowroot, for all that is needed is a good supply of clean pure water and a rough grater. The latter can be made from a side of a kersoene tin, bent into a half-circle and nailed on a board; but before nailing on the board, knock as many holes through it as you can with a large nail or the sharp end of a file. The writer has used such graters frequently, and they answered admirably for grinding up the roots into a pulp. When sufficient pulp has been ground up it should be allowed to soak in water for some time, then rubbed about and strained on a fine sieve. The starchy matter termed arrowroot will sink to the bottom of the water, which may then be poured off. Frequent washings will be necessary before the starch is sufficiently clean and white for use. It should be spread out on clean cloths in the sun to thoroughly dry, after which it can be put away in bottles or jars until required for use. Children can very soon learn how to manufacture arrowroot suitable for home use. The writer used to make quantities before he had attained the age of ten years. The best kind of arrowroot is made from a small-growing plant, *Maranta arundinacea*, which grows to a height of about 2 feet. This plant is not very plentiful in this Colony, and requires a warmer climate than the arrowroot, *Canna edulis*. Either of these had better be planted about the end of the month. Be sure to thoroughly clean the roots before they are ground up when making arrowroot.

Beans, kidney or French.—Sow a few rows from time to time.

Bean, Lima.—This should be treated in the same manner as the kidney bean. The seeds, either in a green or dried state, are used, and not the pods. There is a tall-growing runner variety, and also a dwarf; the first named bears the best beans. Sow the seeds wider apart than those of the French or kidney bean.

Beet, Red.—Sow a little seed in drills 1 foot or 18 inches apart, not deeper than 1 inch.

Beet, Silver.—Manure the ground well for this vegetable, in order to induce the growth of good succulent leaves, for the leaves only are used, and not the root, like the red beet. A single row a few feet in length will be sufficient if the plants are well cultivated and sometimes supplied with a good soaking of liquid manure, made from the droppings of animals.

Cabbage.—Sow a little seed in a seed-bed. Plant out some young cabbages, if you have any large enough to transplant, to a well-dug, well-drained, and well-manured bed.

Cauliflower will succeed best at this time of year in the coolest districts of the Colony. Follow the directions given for the cabbage. Plant out a few plants, and also sow a little seed in the seed-bed.

Carrot.—Sow a few rows of the short as well as medium and long varieties.

Celery.—Sow some seed in a small seed-bed or box. The soil should be made very fine.

Cucumber.—In the warm districts seed may be sown towards the end of the month. The ground should be thoroughly well dug up, well manured, and well drained.

Endive is a kind of chicory used as a salad generally, although it may be cooked as spinach. It is a good wholesome vegetable, but is not used as much as it deserves to be. Seed may be sown this month in a warm corner where frost cannot attack it. When the seedlings are large enough to handle they may be transplanted to a well-manured bed. Plant out in rows about 15 inches apart, and let the plants stand about 1 foot apart in the rows.

Leek.—Sow some seed and plant out.

Lettuce.—Sow a little seed, and plant out when the young lettuces are large enough.

Melons, Rock.—Seed may be sown in warm districts, in the same way as was directed for cucumbers.

Melons, Water.—Sow seed also as above, but the plants must be allowed considerably more space.

Okra or Gumbo.—A vegetable bearing a succulent, gummy, or mucilaginous pod, which is used for thickening soups. Suitable for warm climates. Sow seed in a box or seed-bed, and when the plants are large enough to move shift them to a well-manured bed. Let the plants stand about 2 feet apart each way.

Onions.—Sow a few rows.

Parsnips.—Sow a few rows in just the same way as was advised for carrots. They are very deep-rooting plants, and the soil should be dug to a considerable depth.

Peas.—A few rows should be sown from time to time, especially in the cool parts of the Colony.

Pepper (capsicum).—A plant or two is all that will be needed in a small home garden. The seed may be sown in a box, and the seedlings transplanted when they are a few inches in height. They come to the greatest perfection in the warm climates.

Potato.—Plant out a few rows. Some of the best varieties are Brownell's Beauty, Early Rose, and Kidney.

Pumpkins.—Sow a few seed in ground to be prepared as for cucumbers, using plenty of dung. Sow the seed 6 or 8 in a hole; the holes to be about 8 feet apart, or even more.

Rhubarb.—The present is a good time to sow seed of this vegetable. Roots are generally obtained to plant out and time is thus saved, but in many localities it is difficult to obtain roots when they are required. Sow in drills in a seed-bed, and when the seedlings are large enough to handle transplant to a well-dug and well-manured bed, where they may remain until large enough to plant in their permanent places. There is no necessity to sow much seed, as a dozen plants will suffice for an ordinary family.

Tomato.—Seed may be sown in the open ground in all the warm districts. The best plan is to sow the seed in a box or seed-bed and transplant the young tomatoes when they are large enough to move.

Turnips.—Sow a few rows in drills about 18 inches apart on well-manured ground. It is customary to sow turnips broadcast in vegetable gardens, but this is a mistake, for they can be better attended to, weeded, and thinned if sown in drills. Do not cover the seed with more than half an inch of fine soil.

Vegetable-marrow and Squashes.—Sow seeds in the warm parts of the Colony. The sowing will be the same as that recommended for cucumbers.

Flowers.

During the month of September plants of all kinds make rapid growth, and the garden becomes beautiful with fresh young foliage and numerous flowers. Those who have been watching with interest for their new plants to flower will soon be gratified, for during this and the following month (October) all the spring flowers will have expanded. The anemones, ranunculuses, daffodills, forget-me-nots, pansies, hyacinths, violets, some camellias, early roses, and many other plants should be in bloom. One of the most welcome of little flowers is the sweet violet. Everyone likes the violet, and very properly so, if only for its delicious fragrance; but the best kinds are not always grown, for there are many varieties of more or less merit, and amongst the best are the doubles which succeed well in cool districts. It is a great mistake to allow violets to grow for years in the same spot without taking them up sometimes, dividing and replanting after the ground has been well dug and manured. In some cases it would be advisable to throw away all the old plants and obtain healthy new ones.

Comparatively tender plants, such as bouvardias, may be planted, and they will soon push ahead and make good plants. Bouvardias bear very pretty flowers indeed, and are easy to grow. If the soil should be very dry they will need watering or they will probably die away. There are many varieties, and some of the best are Brilliant, bearing flowers of a bright red colour; *Candidissima*, white, one of the most useful of the bouvardias; Dazzler, scarlet; *Elegans*, brilliant scarlet; *Hogarthii flore pleno*, rosy-salmon, double-flowered; *Humboltii corymbiflora*, large white sweet-scented flower; Laura, pink; *Longiflora Glammea*, rose; Maiden's Blush, a very useful one, flowers pale pink; President Garfield, pale peach, double flowered; Priory beauty, rose-coloured; Triomphe de Nancy, orange-salmon, double-flowered; *Umbellata carnea*, blush; Vreelandii, white; Jacquinii, scarlet, a most useful but old variety; President Cleveland, deep scarlet, single, one of the best of the bouvardias.

Prune back rather hard any old plants of bouvardias there may be growing in the garden.

Plant out pelargoniums or other evergreen plants or seedlings which may be in stock, but be sure to water them well and shade from the sun until they become well established.

Sow seeds of tender annuals and perennials either in the garden or in boxes, or kerosene tins, or anything that will contain soil, so long as it has an opening in the bottom to allow of surplus waters draining away. Anything planted out this month will need a good deal of care and attention, if the weather is hot and dry.

OCTOBER.

Vegetables.

Beans, French or Kidney dwarfs.—May be sown now in nearly all parts of the Colony. It will thrive in almost any kind of soil, provided the soil be thoroughly well drained and well manured.

Beans, Kidney, runners.—These may be managed in the same manner as the dwarfs, but the seeds had better be sown wider apart. They will need the support of poles, or anything else that will support them. For general purposes in small gardens it will be as well to grow only the dwarf varieties.

Bean, Lima.—If seeds were not sown last month this should be done immediately. There is a dwarf as well as a tall-growing variety. The latter bears the largest beans.

Beet, red.—Sow a little seed of this vegetable in rows about 18 inches apart. When the seeds come up and the plants are strong, thin them out gradually until you have strong plants standing about 9 inches from each other. The ground should be dug deep, but should not be freshly manured. Small clean medium-sized beets are to be preferred to those of a larger size. Badly-shaped and forked roots should be condemned.

Beet, silver.—Is used for the leaves only. Sow a little seed in heavily-manured ground. A few plants will be sufficient for an ordinary-sized family.

Cabbage.—Sow a little seed in drills in a seed-bed. Plant out any strong plants that may be available, and do this with care.

Cauliflower.—Sow a little seed and manage the plants as advised for the cabbage. Cultivate the ground with a hoe between the rows of cauliflowers as well as cabbage, and all members of the same class of vegetables.

Carrot.—Sow a few rows or drills about 1 foot or 18 inches apart.

Celery.—Prepare some ground by heavily manuring and well digging, and when some of the best seedlings are ready, transplant them from the seed-bed. Celery requires plenty of water, but the ground should be well drained. When grown on the flat the stalks may be blanched or made white by placing boards on each side, or anything else that will keep away the light.

Cucumber.—Prepare a bed by digging the ground deep, by draining it well, and by applying a good dressing of manure, unless the soil is rich enough without it, as may be the case on some farms. Sow six or eight seeds within a few inches of each other, in a clump, as it were; and about 6 feet distant put in another "clump," and so on until your bed is planted. When the seeds come up and the plants are strong, thin out all but two or at most three plants. If necessary, those you thin out can be moved carefully and planted in another bed, or they may be required to fill up misses. Water the plants before they are moved, and again when planted.

Cress and Mustard.—The seeds of these salad plants are generally sown together. They are wholesome and useful vegetables to eat in a green state, and a few seeds should be sown occasionally to keep up a supply. Use a good dressing of rotted manure and mix it well up with the soil. Mustard and cress are about the easiest of vegetables to grow.

Capsicum or Chilli.—The seed may now be sown in a box or pot, or in a seed-bed, and the young capsicums afterwards planted out about 3 feet apart.

Egg plant.—Sow in the same manner as the above and afterwards transplant. This vegetable requires a very warm situation. It is questionable whether more than a few plants of it are worth growing. The fruit is very ornamental.

Kohl rabi, or Turnip-rooted Cabbage.—A few plants are worth trying. It is not advisable to grow it to any extent until it is ascertained that the family cares for it. Sow and plant as for cabbage.

Leek.—Sow seed and plant out. Water often, and apply abundance of liquid manure.

Lettuce.—The best kind for this time of the year to sow is one of the Drumhead class. Manure well, and use liquid manure frequently to keep the plants growing fast. Sow the seeds in a seed-bed, and when moving the plants be particularly careful not to break the roots.

Melon, Rock and Water.—Prepare the ground as recommended for the cucumber, and sow the seed in the same way. The water-melons should be sown wider apart than the cucumbers or rock-melons.

Okra.—Plant out from the seed-bed any young plants that are strong enough, 2 or 3 feet apart. Sow a little seed.

Onion.—Sow a little seed. Any plants that are growing should be kept carefully weeded, and spread a dressing of soot and salt about them. Half soot and half salt.

Parsnip.—Sow a little seed in rows about 2 feet apart. The ground should be dug as deep as possible.

Peas.—A row or two may be sown. The peas will succeed best during the summer, in the coolest parts of the Colony.

Potato.—Plant out a few rows of medium-sized whole potatoes. Use plenty of manure unless the soil of the garden is sufficiently rich without it.

Pumpkin.—Sow a few seeds of the ironbark variety if it can be obtained. Prepare the ground well and use manure liberally. Sow the seeds in clumps about 8 feet apart, and thin out the plants to two or three when they are strong enough.

Radish.—A few radishes well grown are always useful. It would be as well not to sow too much seed at a time as the roots soon deteriorate. Apply well-rotted manure, and dig up the soil well and make it fine. Sow in rows, and thin out the plants as soon as the second leaves appear.

Rosella.—This is a kind of Hibiscus, which will succeed only in the warmest parts of the Colony. The portion of the plant used is the flower calyx. It makes an excellent and most beautiful coloured preserve. The seed should be sown in pots or boxes, and the plants afterwards transplanted to well-manured ground.

Rhubarb.—A little seed may be sown in a box or seed-pan, but it is rather late in the season.

Tomato.—Plant out largely from the seed-bed, or sow seeds if this has not yet been done. Make some kind of support for the plants to be tied to, so as to keep them off the ground as much as possible. There is no end to the varieties of tomatoes, yellow and red, large and small. The medium-sized and the small are generally the best flavoured, and are on that account to be preferred to the large and handsome kinds. No vegetable garden should be without a few plants.

Turnip.—A little seed may be sown on well-manured ground in drills.

Vegetable-marrow and Squash.—Sow seeds on ground that should be prepared in the same way as that recommended for cucumbers.

Flowers.

During the month of October most of the roses and many other plants are at their best; but, unfortunately, it frequently happens that strong north-westerly hot winds blow severely and destroy the flowers. It is impossible to prevent this, unless the garden be protected by hedges, high paling fences, or buildings, but even then hot air penetrates almost everywhere. When the rose flowers have thus been destroyed they should be cut off, and a fresh supply will be forthcoming before very long.

The chrysanthemum is a flower which seems to be growing in popularity almost everywhere. The plant is one of the easiest to grow, and it will produce flowers without any care; but, in order to obtain flowers of good quality, and up to the mark for exhibition purposes, a great deal of care and constant attention is necessary. Plants can be obtained during the month, and planted out in the open, either amongst other flowering plants or else in a border by themselves, where they can be specially attended to. This latter practice is that generally adopted by those who cultivate chrysanthemums for show purposes. After planting do not allow suckers to grow around the base of the plant, and train it up to a stake which has been driven firmly into the ground for the purpose. Examine the plant frequently, and keep it growing by frequent applications of liquid manure, and if the weather be dry, apply plenty of water, and spray with a syringe in the evening. Caterpillars are great enemies to the chrysanthemums, therefore they should be constantly searched for and killed.

Many varieties of beautiful bulbs will flower during this month if the weather has been favourable. Liliums of varieties, gladiolus, and others should be making fine growth and will flower later on. Tie up the leaves of bulbs such as daffodils, &c., to keep them out of the way and tidy, but do not cut them off—just let them wither away—for they are necessary to elaborate material for next seasons flowers and leaves.

In the semi-tropical coastal districts the gardens can be greatly beautified by the addition of palms and tree ferns. They can be planted out during the month if the weather be not too dry. The Lord Howe Island palms, Kentias or Howeas, are remarkably beautiful and easily obtainable. The fan-leaved palms such as our own cabbage-tree, chamœrops of kinds, livistonas, and sabals are exceedingly handsome when well grown.

Seedlings of tender annuals and perennials may now be planted out in the open, and seeds may be sown, in the open, of such plants as cockscombs, balsams, portulacas, and sunflowers.

Edgings of grass, box, &c., will grow very quickly now, therefore they should be frequently cut and kept trim. Edgings and hedges badly kept are great eyesores.

NOVEMBER.

Vegetables.

Beans, Kidney or French.—In the warmest parts of the Colony, plants raised from early sown seed should now be bearing pods large enough for use. Sow seed largely.

Beet, Red and Silver.—Sow a row or two of seed in well dug up ground.

Broccoli.—Sow a little seed and transplant any strong young plants you may have large enough to put out. This vegetable is very much like cauliflower, and may be grown in the same manner.

Cabbage.—Sow a little seed occasionally, not much at a time, but just sufficient to keep up a continuous supply of plants. Plant out a few strong young cabbages from the seed-bed to some well-manured ground.

Carrot.—Some seed may be sown in drills, and when the plants come up, and have attained a fair size, thin out considerably.

Cauliflower.—A little seed may be sown, either in a box or seed-bed, to be protected from the hot sun. Mulch the surface with some finely broken up dry cow-dung, and do not allow the soil to become dry.

Celery.—Sow a very little seed, if it is thought to be required, in a seed-pan or box, and if there are any plants available plant them out in richly prepared ground, either in prepared trenches or on the flat.

Cucumber.—Sow seed in ground that has been well prepared by deep digging and rather heavy manuring. Draining should also be attended to. Any plants that are up and making headway should be pinched back as they extend their spreading shoots, in order to keep them bushy and compact. Plants which are not growing well should have some liquid manure from time to time, but this should be made very weak.

Cress and Mustard.—Sow seed largely. During the hot weather frequent applications of liquid manure will improve them and make them tender and crisp.

Egg Plant.—Plants from seed sown some little time back should be ready to plant out in the garden, 3 feet or more apart every way. Seed may be sown, if plants have not been raised.

Leek.—Sow a little seed in the seed-bed, for succession. It is always well to have a few young plants ready to put out when required. Plant out a few strong young leeks deep in the soil. Fair-sized plants that are growing well may be earthed up to make the stalks white and tender. This vegetable can be strongly recommended as being most wholesome.

Lettuce.—Plant out a few strong young lettuces from the seed-bed, but make the ground rich with well-rotted manure before planting. They should be grown quickly at this time of the year, or they will probably soon run to seed.

Maize Sweet.—This is a useful and palatable vegetable not often used in this Colony, but common enough and much liked in America. Sow in rows about 4 feet apart, and drop the corn about 1 foot apart in the rows. When it comes up, cultivate the well soil between the rows, but do not draw the soil in a ridge to the plants. Cultivate "on the flat."

Melons.—Sow a few seeds in well-prepared ground, in the same manner recommended for cucumbers. The pie, or preserving melon, should not be forgotten, as it is very productive and useful for preserve.

Okra or Gumbo.—Plant out a few seedlings if any are available, but if not sow some seed. This vegetable is useful for soups and stews. Its young seed pods contain a considerable quantity of glutinous matter, which is said to be wholesome and nourishing. The flowers are pretty, and the plant may be grown for ornamental as well as useful purposes.

Onion.—Sow a little seed, and keep the onion beds free from weeds. Scatter amongst any onions which you may have growing a mixture of soot and salt, half and half. This is a useful stimulant, and it will, in a great measure, prevent the attacks of worms and insects.

Peas.—A few rows should be sown, in cool and moist climates especially.

Peppers, Chili or Capsicum.—Plant out a few seedlings, and, if required, seed may be sown. A very few plants will serve for the purposes of a family.

Potatoes.—A few rows may be planted. Plant only whole potatoes of a medium size. Use plenty of rotten horse or cow dung.

Pumpkins.—Sow some seed in well-manured or rich ground. Plants that are progressing should be kept pinched back to prevent them rambling too much.

Radish.—Sow a little seed from time to time and use the plants as quickly as they are ready. Old radishes are almost useless and indigestible, and should be thrown to the pigs.

Rhubarb.—Sow a little seed in order to raise plants to put out next winter or early spring. This is a useful plant to grow, and no garden should be without it.

Sweet Potatoes thrive best in a warm sandy loam. The tubers will readily start into growth if laid out on a warm bed and covered about an inch or two with stable dung kept rather moist. The cuttings, or rooted plants, should be planted out in rows. These rows should be about 4 feet apart, and the cuttings should be planted 1 foot apart in the rows. When the vines are growing, it would be well to raise them occasionally to prevent them taking root at the joints.

Spinach.—Sow a little seed, but very little.

Tomato.—Sow seed in such quantity as may be required, and plant out from the seed-bed if any plants are available. Keep large plants tied up to some support if possible, and the fruit will then ripen better and be less liable to rot.

Turnips.—Sow a little seed in rows.

Vegetable Marrow and Squash.—Sow a little seed in the same way as recommended for cucumber.

Flowers.

During this month the chief work will be the keeping the weeds in check, trimming edgings and hedges, keeping walks clean and tidy, and grass plots cut short.

Roses should be in splendid bloom, especially the tea-scented and hybrid tea-scented varieties. If the rose seeds or seed vessels be cut off and the little branches on which they were growing be cut back an eye or two, fresh flowers will soon appear. Rose plants which are obtained from the nurserymen are generally grafted on some strong growing stock, and very frequently the stock is allowed to grow in mistake for the proper rose. Instances of this may be seen all over the Colony in the little gardens about town residences. Close attention will soon show the difference in the foliage of the variety of rose used for a stock, and any growth which appears about the stem or from the roots should be cut clean away. Give the roses a gallon or two of liquid manure occasionally, and it will make them thrive splendidly. There is no flower which gives more satisfaction than a rose, for it will stand no end of ill-treatment, and will always respond to attention and care.

Many kinds of bulbs flower well this month, and chief amongst them is the magnificent species known as the Hippeastrum, which is remarkably easy of cultivation, for, once it is planted, it may remain undisturbed for years, and will continue to flower without fail. Do not cut away the leaves of any bulbs which have finished their flowering, but let them die away of their own accord. These leaves gather material from the atmosphere which assists the bulbs to lay up a store of nourishment for the production of flowers next season. As the leaves die off, mark with sticks whereabouts the bulbs are growing, so as not to injure them when digging and clearing up the garden.

Dahlias may be planted at any time convenient. Take care that the tubers have a portion of the crown to each, otherwise they will not grow. The variety known as the cactus dahlia is one of the best to plant, and is coming into great favour. Single varieties, also, are very pretty, and are well worth growing. Some of the striped kinds are remarkably good.

Plant out balsams and any other tender kinds of plants which you may have raised. The balsam needs a rich warm soil to enable it to come to the greatest perfection. It needs also plenty of space in which to grow.

DECEMBER.

Vegetables.

THIS is one of the most trying months of the year for gardens, and there is often some difficulty experienced in raising good vegetables, especially when dry, hot winds occur. There should be no difficulty for farmers and others who keep stock to provide a plentiful supply of material suitable for a mulch in the droppings of animals, straw, and dead leaves. These should be gathered together in a heap, and allowed to rot, or partially rot. This can be done from time to time when convenient. When hot, dry weather is likely to occur a heavy dressing should be spread all over the ground amongst the vegetables. Stirring up the soil frequently, has to a great extent the same effect as a mulch—that is, to prevent soil-moisture from evaporating.

Beans, French, or Kidney.—As soon as old plants have ceased to produce beans they should be cleared away, and the ground can then be used for some other kind of vegetable after it has been well dug up and manured. Sow seed largely.

Brocoli.—A small quantity of seed may be sown, either in boxes or a seed-bed, which should be shaded and watered. When the plants are strong and hardy they should be planted out, about 3 or 4 inches apart, in a small, well-prepared bed, in order that they may develop well for further planting out in their permanent places.

Borecole or Kale.—Sow a little seed, and shade and water as suggested for brocoli.

Cabbage.—Sow a small quantity of seed and treat as above. Strong young seedlings may be planted out to some well-prepared ground.

Cauliflower.—Sow a small quantity of seed and treat them as recommended for brocoli.

Cucumber.—Seed may be sown if more plants are required. The fruit should now be available in quantity. Plants coming on slowly will be improved considerably if supplied with occasional applications of liquid manure, made from horse, cow, or fowl dung, or all three mixed together. It should not be allowed to flow over the leaves when applied.

Celery.—A little seed may be sown during the month so as to have a supply available if required. There is no need to waste seed, for not many plants will be required.

Cress and Mustard.—Sow a little seed occasionally to keep up a supply. Make the ground rich with well-rotted manure.

Egg Plant.—A little seed may be sown, if plants are required.

Maize, Sugar or Sweet.—This is but seldom used in the Colony as a vegetable, but it is well deserving of a trial. The ordinary kinds of maize are not nearly so good for table use as the Sweet varieties. The growing of maize is so well-known in the localities for which it is suitable that there is no need to enter into detail here.

Onion.—Sow a small quantity of seed in drills. Attend carefully to growing plants, and keep them quite free from weeds.

Parsley.—If there are no plants in the garden sow a little seed, for no garden should be without a few plants.

Peas.—In the cool parts of the Colony sow a few peas, and keep the ground between the rows well cultivated in order to retain moisture and destroy weeds.

Pumpkin.—Seed may be sown if more plants are needed, or if the supply from plants already raised does not seem likely to be sufficient for requirements.

Radish.—A little seed may be sown occasionally to keep up a supply.

Spinach.—Sow a little seed of this useful vegetable, which is not grown so frequently as it should be.

Tomato.—There should be an abundance of the fruit of this vegetable in all kitchen gardens at this season of the year. A great deal is generally wasted and allowed to rot, when it could be preserved and made into sauces and so on. Seed may be sown if any more plants are required.

Turnips.—Sow a small quantity of seed in drills, and thin out the plants well when they come up.

Flowers.

A good deal of attention must be given to Chrysanthemums if it be the intention to grow flowers of the best quality. Chrysanthemums will grow almost anywhere, provided they have sufficient moisture, and will produce pretty flowers in great quantity; but it is quite a different matter if extra fine flowers are required. Considerable care must be taken with the plants from their youngest stage until their flowers are in full bloom. They will need watering frequently overhead and to the roots. They should be grown to one stem only, and they should be tied up to a trellis, or to stakes, as they grow. Liquid manure, in a weak state, should be supplied occasionally, and a dressing of farmyard manure—straw and dung—had better be spread over the soil between the plants as a mulch. All suckers should be removed as they grow up around the plants, and insects, caterpillars, &c., must be looked for almost daily. Enthusiasts in Chrysanthemum culture take a great deal of trouble with their plants, much more than is generally supposed. Very good flowers may be grown under ordinary care, however, and they are worth spending some little time over. Chrysanthemums make very pretty pot-plants, for they can easily be trained into a variety of forms, with little more trouble than nipping off the shoots and tying out the branches as they grow.

Dahlias will need good supplies of water, and some liquid manure now and then. They should be tied up to stakes as they grow, for they will need support, their stems being very brittle and easily broken by winds.

Bouvardias, which bear exceedingly pretty and graceful flowers, should now be producing abundantly, and the more frequently the flowers are cut the more the plants will produce. They should be supplied with liquid manure occasionally, if they do not seem to thrive luxuriantly.

Remove the dead leaves of bulbs as they dry up, but do not cut them off whilst they are in a green state. It would be as well to put in two or three sticks around the bulbs, to prevent them being destroyed when digging up the garden.

The Manufacture of Perfumes.*

In connection with the interest lately taken in the manufacture of scent from Australian flowers, the following account of the processes for manufacture of perfumes in France may be of practical value:—

The art of producing scent, which is well understood at Nice, can only be acquired by long practice, by which alone the blending of the primary essences in proper proportions becomes thoroughly understood.

The first process is the extraction of the essences by distillation. A large copper vessel or alembic is filled with water to about two-thirds of its capacity; the flowers to be treated are then introduced, and it is hermetically closed. It is then placed on a fire; usually, in our days, gas or steam is used for this purpose. Steam is generated by this means in the cylinder, and is carried by means of a pipe into a second cylinder, which is constantly kept replenished with cold water, and is furnished with an overflow cock. The pipe, in its passage through the second cylinder, assumes the form of a spiral coil. This coil ends in a cock at the bottom of the cylinder, from which the volatile essence exudes drop by drop as the steam becomes condensed in its passage through the spiral coil.

In this manner the essence is collected in a small glass vessel, while at the same time the water containing a small portion of the scent, and which still remains in the alembic aforesaid, is itself perfumed, and becomes the rose water or orange flower water of trade.

All flowers are not susceptible of this treatment—some of them, such as jessamine, violet, cassie, tuberose, &c., containing no essence, have to be treated by a different process, which will be presently described.

Of the flowers producing essences, the orange flower produces but 1 gramme of essence for 1 kilo of flowers, or but one thousandth part. This essence is styled "neroli," and is the principal essence produced in the district between the Var and the Italian frontier.

The following table will show the proportionate yield of the different flowers:—

Neroli...	1,000 lb. of flowers,	1 lb. of essence.
Rose	25,000 " "	1 "
Geranium	1,000 " "	1 "
Mint	1,000 " "	0·750 "
Orange leaf (bitter)...	1,000 " "	1 "
Lavender	100 " "	0·500 "
Eucalyptus	100 " "	0·500 "

The volatile essences thus obtained, combined and mixed together with a certain quantity of alcohol, are used in the preparation and as the basis of Eau de Cologne, toilet vinegar, lavender water, &c.

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* Report by British Consul Harris, of Nice, France.

There are two processes used for the purpose of extracting perfume from flowers which do not contain the volatile essence.

The first may be described as the cold process, and the second as the hot process.

The former is generally used for cassie (*Acacia Farneriana*), jessamine, jonquils, tuberoses, violets, and some other flowers.

Freshly-gathered flowers are placed upon a layer of pure lard, a quarter of an inch in thickness, spread over a sheet of glass about 2 feet square, which is framed in wood and forms a kind of tray. These trays, sometimes some forty or fifty together, are then piled upon one another. The flowers are changed every twelve, eighteen, or twenty-four hours, according to circumstances, and the process is thus continued until the lard is sufficiently charged with perfume. Jessamine and tuberose are frequently changed, as often as fifty times before the lard is considered to be sufficiently impregnated, cassie and violets from thirty to forty times, and jonquils about twenty times only.

The fat thus obtained can be packed in air-tight tins and conveyed anywhere, and it used to be thus exported in considerable quantities to Rimmel's, in London, from their garden at Nice.

When the hot process is resorted to for the purpose of obtaining the impregnated fat, 20 lb. of grease are placed in a copper vessel, together with some 5 lb. of flowers. The vessel is then placed over a slow fire, and the contents are well stirred. After allowing the compound to boil for ten minutes the vessel is left to cool for some hours. An additional 5 lb. of flowers are then added, and the process is repeated until the fat has absorbed the requisite amount of perfume. The hot liquid is then poured through a sieve, and the greasy flower-paste that remains is subjected to hydraulic pressure. It is in these two ways that the "pomades" of trade are produced.

From these "pomades" perfumed and alcoholised liquids are extracted by means of grain spirit, and also by spirits of wine. These are the "extracts" of trade, and it is by the judicious blending of the different essences and concentrated perfumes, obtained by the processes above described, that the numerous scents are produced. The machinery used in their production is very simple.

There are certain perfumes which can only be obtained, however, by fermentation of certain fruits, flowers, and roots, with alcohol; of this nature are benzoin (tonquin bean), iris, and others which are of great use in the manufacture of scents.

Export and Foreign Markets.

With our huge producing areas and relatively sparse population, we must look to foreign markets for the consumption of surplus products.

In the past this necessity has not been sufficiently recognised, with the result that many growers have not managed to secure profitable outlets for their products.

The discouraging remark, "What's the use of growing a crop of so and so when you can get nothing for it?" is so frequently heard that one would be disposed to think over-production was general. Thus we hear of hundreds of tons of good fruit rotting on the ground annually, thousands of tons of potatoes, maize, chaff, and other produce wasted for want of markets, while all the time the possession of a little knowledge as to what to grow, and how to handle the crops when grown, would possibly give us as consumers the teeming millions of Europe.

Nature has given us conditions of soil and climate of such wonderful diversity that within our own borders we can produce crops proper to all situations, from sub-tropical down to lowest temperature.

Recognising the difficulty of getting producers in touch with the consumers of other nations without loading their produce with heavy charges, the Government, a few months ago, appointed a Board for Exports for the purpose of advising and directing as to the best means of attaining this end. This Board consists of nine gentlemen, representing all our producing interests, and various recommendations have been made to the Government as to our position as producers and the proper means of increasing our output. It is anticipated that the suggestions of the Board will have an immediate effect in ameliorating the conditions of marketing at present obtaining, and opening out new and untried markets for such products as we can best supply.

Already the efforts of the Board have culminated in the establishment of a large and lucrative trade in the exportation of hares and poultry, while the export of fruit, grain, and other commodities is attracting much attention.

As rapidly as is consistent with proper consideration, it is intended to deal with our various industries, and show practically how best to take advantage of our magnificent capacity for production.

It is hoped that advantage will be taken of the facilities this Board offers for obtaining information as to the best means of producing, preparing, and forwarding, and also as to the best markets from time to time available.

The programme of the Board also includes a strict system of examination and the grading and branding of all goods intended for export. This system will not only prevent inferior goods being put on the market to the detriment of those who endeavour to maintain a high standard, but will also have the great advantage of offering a guarantee to the foreign purchaser that the produce sent is of a certain standard of excellence, thereby enabling financial arrangements to be made under more favourable conditions.

Notes on Preservatives for Food.

Questions are continually directed to the Department as to the advisability or otherwise of using certain chemical substances for preserving perishable food-stuffs, such as milk, butter, meat, tinned fruits, &c. The following notes on some of the most common of these preservative agents may, therefore, be of interest:—

Many of the substances used with this object, under their own or a fictitious name, are undoubtedly injurious to health when used in any considerable quantity.

Such are boric acid and borates (borax), salicylic acid and its compounds, sodium fluoride, sulphurous acid and sulphites, and alkaline carbonates.

Most of these substances are capable of acting as preservatives or antiseptics in doses sufficiently small to be practically harmless. At the same time there is always the risk that prolonged use of small quantities may be just as injurious to the system as an overdose. Again, although the drug in question may have no effect upon a mature person in good health, it may have serious consequences when mixed with the food given to invalids or to children. And on this account the addition of such substances, to milk in particular, cannot be viewed too unfavourably.

Their use is also objectionable for another reason, namely, the temptation they offer to the manufacturer, or to the purveyor, of masking imperfections in the food to which they are added, and of making him careless as to its preparation and the cleanliness of the vessels employed.

There is, further, always the danger that an unintentionally large dose may have been added.

There is always more likelihood of too large a quantity being added than too small a one, and this is especially liable to occur in the case of milk "preserved" with boric acid, the antiseptic action of which substance in milk is very slight.

Against this danger the consumer has no means of guarding, and he is only aware of it when it is too late.

There are, of course, other perfectly harmless preserving substances, such as salt or sugar, though the use of salt in tinned substances is objectionable.

Milk is the article most frequently bolstered up with chemical preservatives, and the one in which their presence is most particularly objectionable. Milk can be partially sterilised by boiling, or simply heating for twenty minutes at a temperature between 122° and 149° Fahrenheit, immediately closing the vessel in such a manner that air cannot enter. This treatment practically arrests all fermentation, and keeps the milk perfectly sweet until the vessel is opened.

It is, of course, perfectly unobjectionable, and being cheap and simple it seems a pity that it should not be adopted whenever practicable in preference to the addition of chemicals which are, to say the least, of doubtful benefit.

Boric acid and *borax* (which is a sodium salt of boric acid) are amongst the preserving agents most frequently employed. They are extensively used in the preparation of different "patents." For instance, a substance sold under a fancy designation which was examined some time ago at the Department, proved to be a mixture of borax, boric acid, and common salt. Similarly, another preparation proved on analysis to be composed of borax, salt, saltpetre, and sugar.

Against the use of such mixtures the same objections hold as against the separate ingredients, with the additional objection that the nature and quantity of the components are kept secret as far as possible.

The action of boric acid and of borax upon the system appear to be very similar. In concentrated solution (4 per cent.) boric acid causes violent pain and diarrhœa. Smaller quantities hinder the absorption of food, a dose of anything over ½ gram (7½ grains) per diem hinders food-absorption. Now, in order to exert any antiseptic action in milk, boric acid must be present in the proportion of 2 grams per litre (about 15 grains to the pint). So that if the milk contains a sufficiency of boric acid to arrest the development of micro-organisms, each pint of it will contain almost double the quantity which suffices to impair the digestion.

Sodium carbonate and *soda* are often added to milk for the sake of masking the acidity or sourness of stale milk. Their use is altogether inexcusable, as they are not preservatives and are exceedingly injurious.

Salicylic acid possesses powerful antiseptic properties. It is used more commonly in alcoholic liquors, such as wine and beer, since it is very sparingly soluble in water, one part of salicylic acid requiring 400 parts of water for its solution. Its action on the system is to cause fulness in the head when taken in moderate doses. Larger doses produce headaches, affect the sight and hearing, and induce excessive sweating. Its action on the kidneys is especially marked, and its use particularly harmful to sufferers from kidney complaints. In very dilute solution it appears to be harmless, and owing to its strong antiseptic properties there is no reason to employ it in anything like dangerous quantities. One-twentieth of a gram is said to be sufficient to preserve 1 litre of beer (that is about 4 grains per gallon), whereas about 30 grains per gallon have been proved to be without effect upon the health. On this account it is the least objectionable of the preservatives under discussion. Nevertheless, its use in both France and Germany is forbidden, as is also the use of borax and boric acid. In France the prohibition is absolute, the reason being given that, although its use in small quantities would probably not injure healthy people, it may, nevertheless, produce decided disorders of health in the old, or in those who have a tendency to diseased kidneys or dyspepsia.

Sulphurous acid, sodium sulphite, sulphite of lime, or sulphur fumes, are employed more especially in the preparation of the casks for holding wine. When properly managed there is no danger of more than traces of the acid getting into the wine, and in such small quantities it is harmless. One-half grain sulphurous acid, by weight, is sufficient to prevent the ordinary diseases of wine in every gallon, and as much as 4 grains per gallon may be taken without danger.

At the same time it must not be forgotten that it is a poison, and although there is no likelihood of the practice of sulphuring wines being discontinued, it is as well to remember that it is not unattended with risk.

Diarrhœa and vomiting are the preliminary effects of its use in excessive quantities. The use of sulphurous acid and its compounds are also prohibited in France and Germany.

The question of "plastering" wines also comes under the same heading. In France the maximum quantity of sulphate of potash permissible in wine offered for sale is 120 grains per gallon, whether such addition has been made by plastering the must or by adding plaster or sulphuric acid to the wine.

Enough has been said to show that the addition of any of the substances enumerated above to any article of food is to be viewed with distrust, such additions not being harmless in themselves, and serving often to hide imperfections in the food; further, that substances, the nature of which is unknown (all secret preparations), should not be tolerated on any account. One such "secret" preservative preparation which has come under my notice, and is in use here, professes to be a compound which has "defied analysis." This, if it were true, instead of counting in its favour (as the proprietors evidently intend it should), ought to be sufficient to render its use illegal, for if it cannot be analysed, there is no means of pronouncing beforehand either upon its efficiency or its harmlessness.

It should be impossible to expose for sale, or to use, any addition to food without a proper guarantee of the exact nature and proportion of its ingredients, and it is preferable to avoid any such addition whatever.

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